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Introduction

This document contains the output draft of Q.FMC-IMS resulting from discussions at the NGN-GSI meeting held in Geneva from 11 – 21 September, 207.

Compared to the previous version a major restructuring of the draft has been implemented to improve to flow of the document, balance the level of detail in various sections and remove material that is not directed related to scope of Q.FMC-IMS. It also incorporates new or updated material on network and convergence architectures from other SDOs. .

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Working Draft of Q.FMC-IMS:

Fixed mobile convergence with a common IMS session control domain

Summary

This Recommendation describes principles and requirements for IMS based convergence of fixed and mobile networks ("fixed-mobile convergence, (FMC)"). This convergence of fixed and mobile networks enables mobile users to roam outside the serving area of their mobile networks and still have access to the same set of services outside their network boundaries as they do within those boundaries, subject to the constraints of physical access and commercial agreements. This Recommendation also describes the general framework for fixed-mobile convergence and the mobility management functional requirements that must be satisfied in fixed networks to achieve this convergence.

This Recommendation is focused on future IMS-based Networks, although some legacy fixed network requirements are also addressed.

Keywords

IMT-2000, convergence, fixed, mobile

1 Introduction

The evolution of individual core network technologies towards common Internet Protocol (IP) based solutions provides long term opportunities for the convergence of diverse network technologies and the convergence of fixed and mobile networks. The~~is~~ fixed-mobile convergence provides, in turn, opportunities for extending the reach and scope of services ~~that a user of such networks may obtain~~ beyond what could be supported in the pre-converged environment.

Recommendation ITU-T Q.1761 “Principles and Requirements for Convergence of Fixed and Existing IMT-2000 Systems” addresses the opportunities in the near to medium term that may be enabled by providing capabilities to enable IMT-2000 roaming users to access their basic and enhanced services. ~~, possibly excluding terminal mobility, in environments where IMT-2000 is not yet deployed.~~

This draft ~~new~~ Recommendation moves ~~on~~ one step further from Q.1761 to address the longer-term fixed-mobile convergence opportunities offered by IMS-based Networks.

2 Scope

~~[Note: Check against other ITU NGN documents to clarify the usage of “terminals” or “user equipment]~~

This recommendation describes a network architecture that uses IMS (Y.IFN) to provide the same set of services to user terminals regardless of the use of fixed or mobile access network technologies, and to ensure service continuity when the point of attachment of the terminal changes between ~~fixed and mobile~~different access network technologies.

~~This recommendation also describes network architectures that allow service continuity between the fixed and the mobile access technologies if the session control layer corresponding to one of the access technologies is IMS (e.g. handover of voice calls between the mobile circuit domain and the fixed network controlled by IMS).~~

~~The architecture employs the functional entities defined in Y.IFN for IMS related entities, and Y.FRA for non-IMS related entities. This recommendation details the architectural entities which are generically defined in Y.FRA and Y.IFN (e.g. application servers).~~The architecture employs the functional entities groupings defined in Y.2021IFN for IMS related entities, and Y.2012FRA for non-IMS related entities functionality. This recommendation details IMS FMC specific architectural entities requirements which are generically defined in Y.FRA and Y.IFN (e.g. for application servers).

3 References

The following ITU-T Recommendations and other references contain provisions, which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

3.1 Normative References

[1] ITU-T Recommendation Q.1701 (03/1999) Framework for IMT-2000 Networks

[2] ITU-T Recommendation Q.1702 (06/2002) Long-term vision of network aspects for systems beyond IMT-2000

[3] ITU-T Recommendation Q.1703 (xx/xx) Service and Network Capabilities Framework of Network Aspects for Systems Beyond IMT-2000

[4] ITU-T Recommendation Q.1711 (03/1999) Network functional model for IMT-2000

[5] ITU-T Recommendation Q.1741.1 (04/02) IMT-2000 references to release 1999 of GSM evolved UMTS network with UTRAN access network

[6] ITU-T Recommendation Q.1741.2 (12/02) IMT-2000 references to release 4 of GSM evolved UMTS core network with UTRAN access network.

[7] ITU-T Recommendation Q.1741.3 (08/03) IMT-2000 references to release 5 of GSM evolved UMTS core network with UTRAN access network.

[8] [ITU-T Recommendation Q.1741.4 (05/05) IMT 2000 References to Release 6 of GSM evolved UMTS Core Network]

[9] ITU-T Recommendation Q.1742.1 (12/02) IMT-2000 References to ANSI-41 evolved core network with cdma2000 Access Network

[10] ITU-T Recommendation Q.1742.2 (xx/xx) IMT-2000 References to ANSI-41 evolved core network with cdma2000 Access Network

[11] ITU-T Recommendation Q.1742.3 (06/03) IMT-2000 References to ANSI-41 evolved core network with cdma2000 Access Network

[12] ITU-T Recommendation Q.1742.4 (12/04) IMT-2000 References (approved as of 30 June 2004) to ANSI-41 evolved Core Network with cdma2000 Access Network

3.2 Informative References

[1] Supplement 47 to the ITU-T Q series Recommendations Emergency Services for IMT-2000 Networks – Requirements for Harmonization and Convergence

[2] Supplement 52 to the ITU-T Q series Recommendations ——Technical Report on NNI Mobility Management Requirements for Systems Beyond IMT-2000

[3] IEEE P802.21 D01.00 Media Independent Handover Services

[4] 3GPP2 X.S0013-000-A All-IP Core Network Multimedia Domain; Overview

[5] TS 23.401 GPRS enhancements for E-UTRAN access; (Release 8)

[6] TS 23.402 Architecture Enhancements for non-3GPP accesses (Release 8)

4 Definitions

~~[Editors~~Editor's note: This section has not been updated since the September 2005 meeting. Definitions need to be aligned with those in Q.MMR. Contributions are invited~~]~~

Convergence	Coordinated evolution of formerly discrete networks towards uniformity in support of services and applications.

Emergency call	A call requesting emergency services. A caller is given a fast and easy means of giving information about an emergency situation to the appropriate emergency organization (e.g. fire department, police, ambulance). Emergency calls will be routed to the emergency services in accordance with national regulations.
IEPS	Allows an authorized user to have access to the International Telephone Service while the service is restricted due to damage, congestion and/or other faults. The International Emergency Preference Scheme (IEPS) is needed when there is a crisis situation, which causes abnormal telecommunication requirements for governmental, military, civil authorities and other specially authorised users of public telecommunications networks.
Discrete Mobility	See Nomadism.
Discrete Terminal Mobility	Ability to have discrete mobility using the same terminal.
Fixed Mobile Convergence	Use of wired and wireless access technologies in conjunction with IMS-based [Core[1]] Networks.
Handover (Supplement 52 to Q Series)	The ability of a mobile user/terminal/network to change location while media streams are active.
Home Network (Supplement 52 to Q Series)	The network to which a mobile user is normally connected, or the service provider with which the mobile user is associated, and where the user's subscription information is managed.
Visited Network (Supplement 52 to Q Series)	The network outside home network that provides service to a mobile user.
Mobility Management (Supplement 52 to Q Series)	The set of functions used to manage a mobile user accessing a local network other than that user's home network. These functions include communication with the home network for purposes of authentication, authorization, location updating and download of user information.

Network Mobility (Supplement 52 to Q Series)	The ability of a network, where a set of fixed or mobile nodes are networked each other, to changes, as a unit, its point of attachment to the corresponding network upon the network's movement itself.
Mobility	Ability to provide services irrespective of changes that may occur by user/terminal's activities. The user is able to change his network access point, as he moves, without interrupting his current service session, i.e., handovers are possible. In some situations, the handover may lead to a briefly suspended service session or it may require a change in the level of service provided as a consequence of the capabilities of the new access point to which the user has become connected through the handover process. Supplement 52 to Q Series - The ability for a user to access subscribed services while in motion, and the capability of the network to identify and locate the user's terminal.
Nomadism	Ability of the user to change his network access point after moving; when changing the network access point, the user's service session is completely stopped and then started again, i.e., there is no handover possible. It is assumed that normal usage pattern is that users shutdown their service session before moving to another access point or changing terminal. This is the mobility alluded to in the case of fixed mobile convergence.
Personal Mobility	Ability of a user to access telecommunication services at any terminal on the basis of a personal identifier, and the capability of the network to provide those services according to the user's service profile. Note: Personal mobility involves the network capability to locate the terminal associated with the user for the purposes of addressing, routing and charging of the user's calls.
Roaming	Ability to provide service to a user through access from a network other than the network to which he has subscribed. Supplement 52 to Q Series - The ability of a mobile user to get connectivity from visited network." During roaming, a user is able to change network access points as he moves. However, his current service session is completely stopped at the old location and a new session is started at the new location, i.e., there is no handover.
Terminal Mobility	Ability of a terminal to access telecommunication services from different locations and while in motion, and the capability of the network to identify and locate that terminal Supplement 52 to Q Series - This is mobility for those scenarios where the same terminal equipment is moving or is used at different

	locations. The ability of a terminal to access telecommunication services from different locations and while in motion, and the capability of the network to identify and locate that terminal.
Seamless Handover (Supplement 52 to Q Series)	The process by which latency and data loss incurred during handover is within the range to be acceptable to the users, (e.g., below a certain limit) for real-time services.
Seamless Service (Supplement 52 to Q Series)	Seamless service will prevent users from experiencing any service disruptions while maintaining mobility.

5 Abbreviations

<Include all abbreviations used in this Recommendation>

2G Second Generation

3G Third Generation

AT Access and Terminals

CN Core Network

EFN Evolved Fixed Network

EG ETSI Guideline

ES ETSI Standard

ETSI European Telecommunications Standards Institute

FMC Fixed Mobile Convergence

GSM Global System (for) Mobile (Communications)

IMT-2000 International Mobile Telecommunications - 2000

IEPS International Emergency Preference Scheme

IP Internet Protocol

ISDN Integrated Services Digital Network

ISP Internet Service Provider

LAN Local Area Network

PSDN Packet Switched Data Network

PSTN Public Switched Telephone Network

SMS Short Message Service

UPT Universal Personal Telecommunications

USO Universal Service Obligation

VHE Virtual Home Environment

WISP Wireless ISP

WLAN Wireless LAN

WLL Wireless Local Loop

6 Conventions

There is no particular notation, style, presentation, or other conventions used within this Recommendation.

7 Convergence boundaries

There are different ways to provide FMC capabilities, determined by the location of convergence functions in the overall NGN architecture. Those aspects are highlighted in the following diagram:

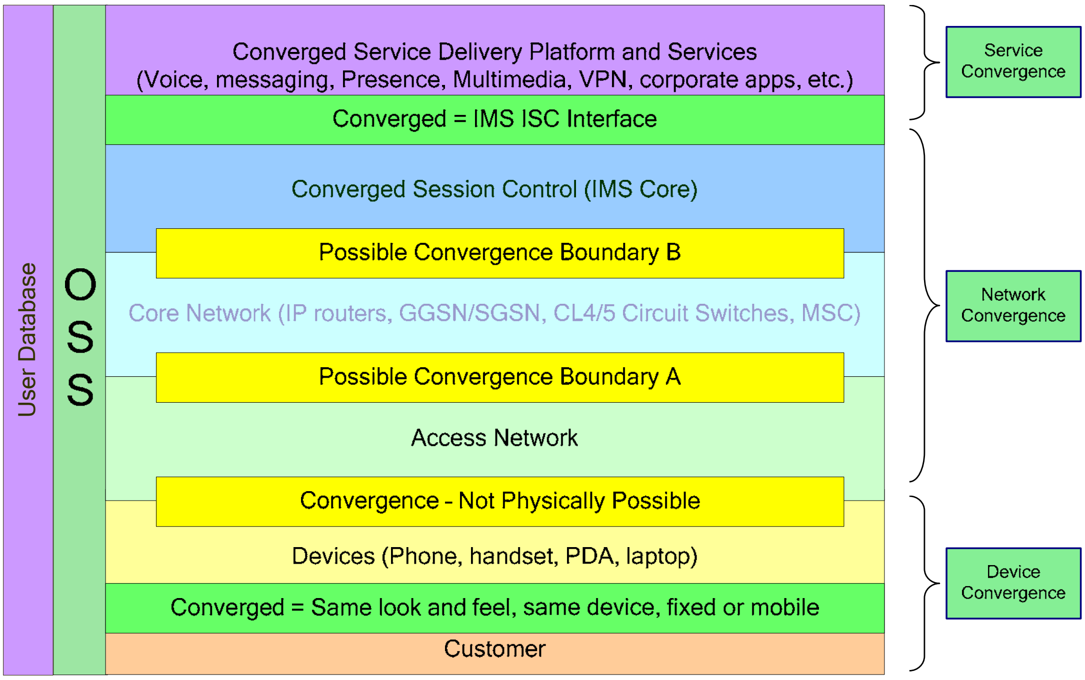

Figure 1. Convergence boundaries

From the network control perspective, with IMS as session control, there are two potential boundaries for convergence. One is at the boundary between the core network and the session control domain ("Possible Convergence Boundary B" in figure 1). The other possible convergence boundary is between the access network and the core network ("Possible Convergence Boundary A" in figure 1).

End users and service providers may perceive convergence differently. End users focus on device and service convergences while service providers focus on network and service convergences. The common objective for both end users and service providers is to achieve service convergence, i.e. seamless and boundaryless services. This is the ultimate objective of FMC.

This recommendation is focused on the Network and Service Convergences.

~~7~~8 ~~Convergence scenarios~~Converged network

The FMC concept involves the convergence of the fixed network and mobile network. Hence the discussion of FMC will always involve two types of networks; one is the fixed network and the other is the mobile network.

For the mobile network side, the following candidate technologies may exist for possible convergence with the fixed network.

1. IMS domain: This refers to is usinge the 3GPP defined IMS domain to provide IMS services

2.(CS+PS)@CSI: The voice part of the multimedia session uses the circuit bearer (PLMN-CS), and the packet bearer (PLMN-PS) is to provide non-voice components. The sessions are under IMS control.

3.2.PLMN-CS: The circuit bearer is to provide voice services, and is not under IMS control.

4.3.PLMN-PS: The packet bearer is to provide packet services, and is not under IMS control.

The fixed network can be further divided into the following three technological sub-categories in terms of technology for possible convergence with the mobile networks.

1. Wireless: The user device is toterminal accesses the fixed network via wireless connectivity (e.g. IEEE 802.11). The user can may use the same terminal device to access both the mobile network and the fixed network (dual mode terminals). The control aspect of for this type of fixed network can be:
    a. IMS control. The IMS functionality is defined by Y.IFN, which includes extension to the 3GPP R6 IMS to support fixed broadband access.
    b. UMA (Unlicensed Mobile Access)
2. Fixed Broadband: The user device terminal use wired accesses to the fixed network via wired connectivity. The user can not use the same device to access both the mobile and the fixed networks. The FMC, in this context, is to provide better user experience when a better terminal is available (e.g. IPTV with large screen TV available in the house). The control aspect of for this type of fixed network is:
    a. IMS
3. PSTN: The user device is the traditional fixed telephony terminal. The user can not use the same device terminal to access both the mobile and the fixed networks. The FMC, in this context, is to provide better voice services when a traditional reliability of PSTN can be enjoyed (e.g. lack of in-door wireless coverage). The control aspect of for this type of fixed network can be:
    a. PES with IMS
    b. UMA-J: (UMA Junior),) POTS is connected to the mobile PLMN-CS, using gateways.
    c. PSTN switches
    d. PES with Call Servers (PES@CS)

9 Service continuity

From the FMC concept, the converged network will exhibit, to certain extent, the following two important aspects:

1.For both the fixed and mobile networks, the converged network will have almost identical architectural components. The degree of convergence may be measured by the ability to reuse the architectural components.

2.Service continuity. Service continuation can be exhibited on the same terminal or on different terminals. The service continuity can be further classified into the following three major categories:

a. MSC: Multi-media Service Continuity

b. VSC: Voice Service Continuity

c. RSC: Registration Service Continuity

Multi-media services consist of partial or full combination of Data services, voice services, and video services. The service continuation of multi-media services ~~will~~ includes the service continuation of respective services and the required synchronization between them. ~~The fulfillment of those aspects may serve as a measure of convergence inside the network.~~

The Voice Service Continuity provides seamless voice services to subscribers across different network boundaries.

Registration Service Continuity provides transparent registration services across different terminal boundaries or across different network boundaries.

~~In terms of~~For service continuity, there are three major scenarios to be addressed

1. Service continuity on the same user device. The figure below illustrates this case, and the possible service continuity scenarios are outlined in the table below.

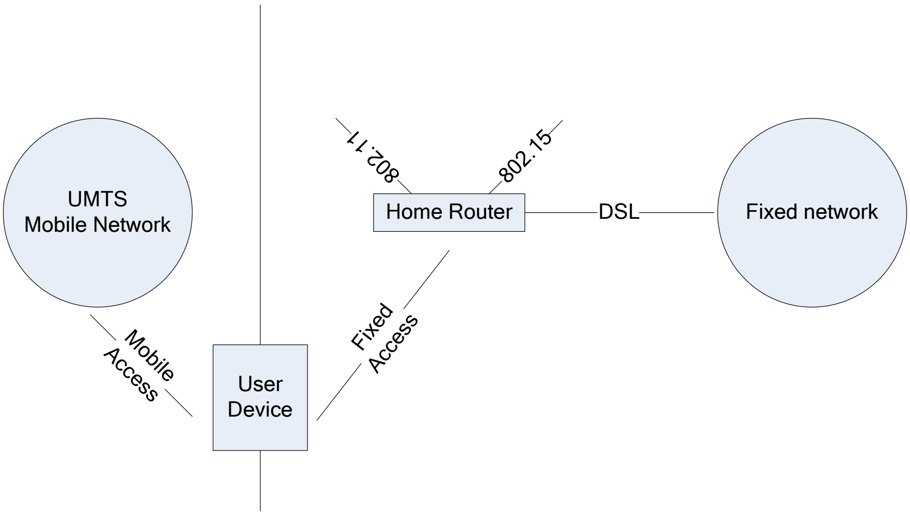

Figure 2~~1~~: ~~FMC~~ Service continuity on the same terminal

-	~~Fixed~~	~~Wireless (802.11)~~

-	Fixed	Wireless (802.11)	
Mobile	***Control Technology***	IMS	UMA
UMTS	IMS - PS	RSC/MSC	RSC/MSC
	IMS - (PS+CS) (CSI)	RSC/MSC	RSC/MSC
	PLMN - CS	VSC[2]	***N/A***[3]

[2] This is the VCC discussed in 3GPP.

Mobile	Control Technology	IMS	UMA
UMTS	IMS	MSC	MSC
	(PS+CS)@IMS (CSI)	MSC	MSC
	PLMN - CS	VSC[4]	N/A[5]
	PLMN - PS	RSC[6]	N/A[2]

Table 1 Service Continuity on the same user device

2. Service continuity on different multimedia user devicesterminals. The rationale for this case are
   a. Obtain better in-house coverage without special dual mode terminals
   b. Conserve mobile bandwidth by using fixed broadband technology whenever possible
   c. Enjoy services provided by powerful multimedia terminals with higher bandwidth via fixed access

   This FMC scenario can be illustrated in the following figure, with possible service continuity situations outlined in the companion table.

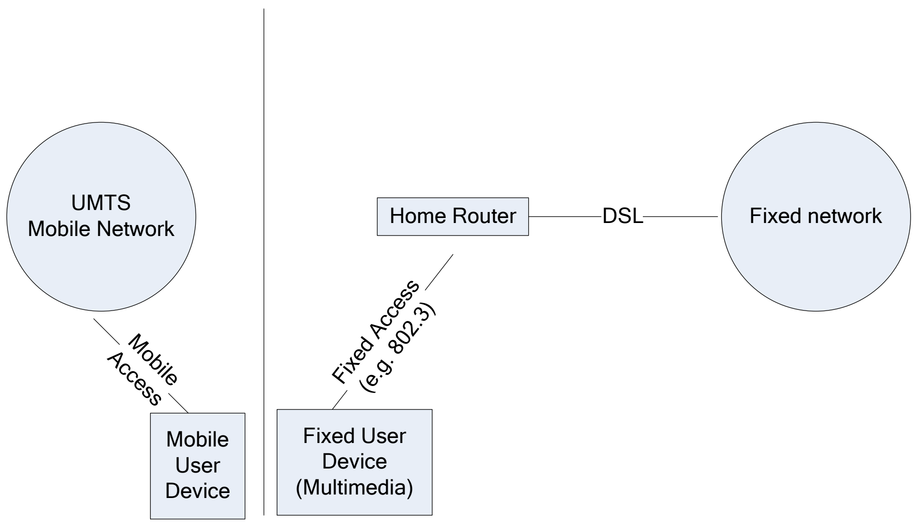

Figure 32 Service Continuity on different multimedia terminals

The service continuity capabilities are outlined below:

	Fixed Access	Fixed Packet Access
Mobile Access	*Control Technology*	IMS

[3] N/A under the context of IMS based FMC, since there is little IMS related involvement inIMS is not involved in supporting theose services.

[4] This is the VCC discussed in 3GPP.

[5] N/A under the context of IMS based FMC, since there is little IMS related involvement in supporting those services

[6] RSC only applies to from IMS to PLMN-PS, and not from PLMN-PS to IMS

UMTS	IMS-PS	MSC
	IMS- (PS+CS)~~@IMS~~ (CSI)	MSC
	PLMN - CS	VSC

Table 2 Service Continuity on different multimedia terminals

3. Service continuity on different telephony (voice only) ~~devices~~terminals. The rationale for this case is similar to that of the multimedia terminal case. The key aspects are not using the special dual-~~-~~mode terminal while still getting the same benefits of bandwidth conservation for mobile, ~~and~~ better ~~terminal~~ voice quality ~~capability (codex)~~ and better signal coverage ~~once~~ whenever fixed access is ~~possible~~available. The following table outline the configuration

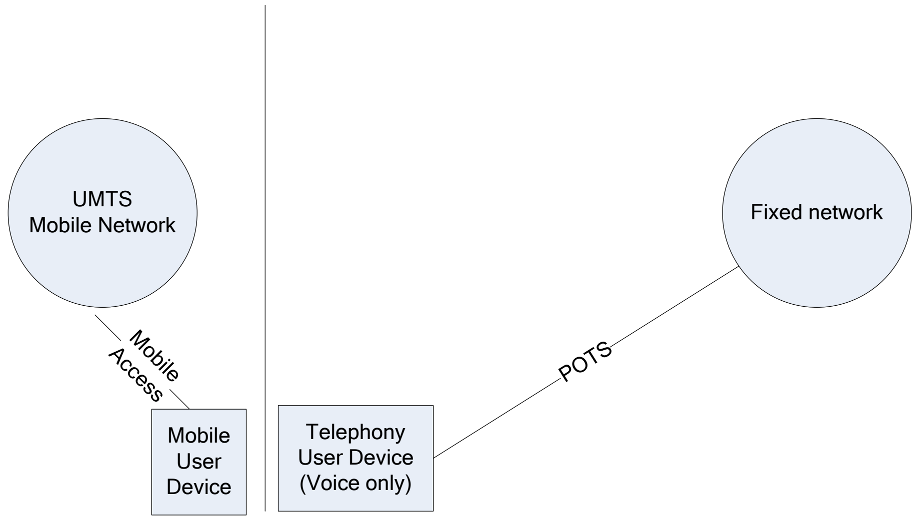

Figure 4~~3~~ Service Continuity on different telephony terminals

The service continuity capabilities via various voice technologies on the fixed network part can be outlined in the table below:

	Fixed Access	PSTN I/F			
Mobile Access	***Control Technology***	PES@IMS	UMA-J	PSTN	PES@CS
UMTS	IMS	VSC	VSC	VSC	VSC
	IMS - (PS+CS) ~~@IMS~~ (CSI)	VSC	VSC	VSC	VSC
	PLMN - CS	***N/A*** [1]	***N/A*** [1]	N/A [1]	N/A [1]

Table 3 Service Continuity on different Telephony terminals

~~8~~10 IMS based FMC Architecture

~~8.1High Level Architecture~~

The high level FMC architecture ~~of the FMC scenarios that are studied~~defined in this recommendation is depicted in figure 5~~1~~. The architecture assumes a common IMS service platform for the delivery of services over fixed and mobile networks.

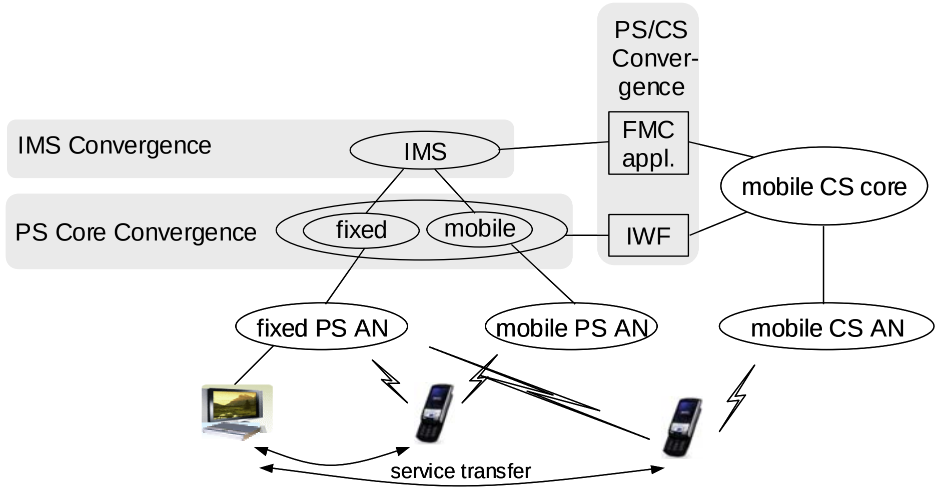

Figure 5~~1~~ – IMS based FMC architecture

This converged IMS platform may be used to transfer services between terminals attached to different networks based on reachability, user preferences or at the user's explicit request. It may also be used to transfer services from one access to another to provide service continuity for multi-mode terminals that can attach to both fixed and mobile access points. IMS based service level transfer and handover is one of the architectures studied in this recommendation.

The alternative for service level handover is transport level handover through a suitable mobility management protocol. This type of handover requires a common packet switched core where the authorization of network attachment and the QoS context of the attachment can be transferred from one access to another. PS Core convergence to enable transport level handover is another architecture that is studied in this recommendation.

In view of the ubiquitous deployment of circuit switched mobile networks this recommendation also considers architectures to provide service continuity between an IMS controlled packet switched network and CS mobile networks. This type of architecture requires specific PS/CS convergence functions to bridge the IMS controlled network ~~to~~ and the CS network. These are represented by a service level FMC Application and a transport level ~~Media Gateway~~inter-working function (IWF) in figure 5~~1~~. The convergence functions are drawn between the two networks to illustrate their bridging nature. They will however be contained within the IMS network as the intent of the architecture is to reuse existing CS interfaces.

Note that IMS based PSTN/ISDN emulation could also be considered as an IMS based FMC architecture, since the converged IMS may provide services to mobile as well as PSTN/ISDN terminals. This FMC scenario not depicted in Figure 5 is detailed in Y.PIEA and is outside of the scope of this recommendation.~~ and therefore not depicted in figure 1.~~

8.2Mobility Management

The general environment for networks is mainly focused on the coexistence of complementary technologies, in particular for access techniques, and the future development of multimode and adaptable terminals and adaptable services. In a first step, these various technologies need to be linked to achieve interoperability, and in a further step, integration should be considered.

IP in the core network for the transfer plane will enable the bridging of diverse fixed and wireless technologies such as those listed above. However, interoperability of the various access means at the transfer layer is not sufficient to achieve the above goals. In order to support global mobility in such heterogeneous environment, further work is needed to develop network functions at the control layer, including:

- identification and authentication mechanisms
- access control and authorisation function
- IP address allocation and management
- user environnent management (VHE)
- user profile management
- access to user data

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11.1 Reference model

Fixed mobile convergence's The long term goal for Fixed Mobile Convergence is to provide users with seamless services across fixed and mobile environments. It doesn't matter from the user's perspective how this seamless service experience is achieved. This is however very relevant from a network operator perspective, because it does impact the cost for providing such services. In this draft recommendation, the convergence of fixed and mobile network components is considered as a means to support access technology independent services.

Figure 61 depicts the network domains that we can distinguish in both fixed and mobile networks in order to describe different level of convergence that operators may take to achieve certain levels of convergence.can be achieved. This serves as an abstracted IMS-FMC reference model from a service provider's perspective.

The Access Transport Domain provides the connectivity between the User Equipment Domain and the access technologiesy independent of Core Transport Domain. Within the Access Transport Domain we can distinguish the physical access media dependent Radio/Wired Access Domain that connects User Equipment to the access nodes of the network (e.g. DSLAMs, 3G Base Stations and RNCs, WLAN Access Points etc.) and from the Access Aggregation Domain that aggregates the traffics from multiple Radio/Wired Access Domain instances to an edge node that connects to the Core Transport Domain.. GPRS, part of the 3GPP IP Connectivity Access Network, is an example of an Access Aggregation Domain and so is the network that connects DSLAMs to a BRAS/IP Edge device. A mobile Access Aggregation Domain will shall contain mobility management functions.

The Core Transport Domain may also contain mobility functions in order to support mobility across different Access Domains (e.g. MIP Home Agents). The Core Transport Domain interconnects with Access Domains within the same network to each other and the Core Transport Domains of to other networks, to supporting media processing functions as necessary. Network attachment, and resource and admission control functions are contained in both the Access and Core Transport Domains.

IP in the core network for the transport plane can enable the bridging of diverse fixed and wireless technologies. However, interoperability of the various access technologies at the transport layer only is not sufficient to support global mobility in such heterogeneous environment, control layer works, such as identification and authentication mechanisms, access control and authorization function, IP address allocation and management, user environment management (VHE), user profile management and accessibility to user data are required to achieve the true convergence across different access technologies and across different networks.

Session control of connectivity between User Equipment and other networks is provided by the Session Control Domain that also contains functions in supporting of presence and location services. The Session Control Domain interfaces with the Core Transport Domain to convey transport resource requests and NAT binding information, if applicable. It may also interface with the Access Transport Domain, for instance to convey location information in case of a Wired Access Domain.

Finally there is the Application Service Domain that containings functionality that supports so-called application services such as messaging and information services that may be built on top of session control services.

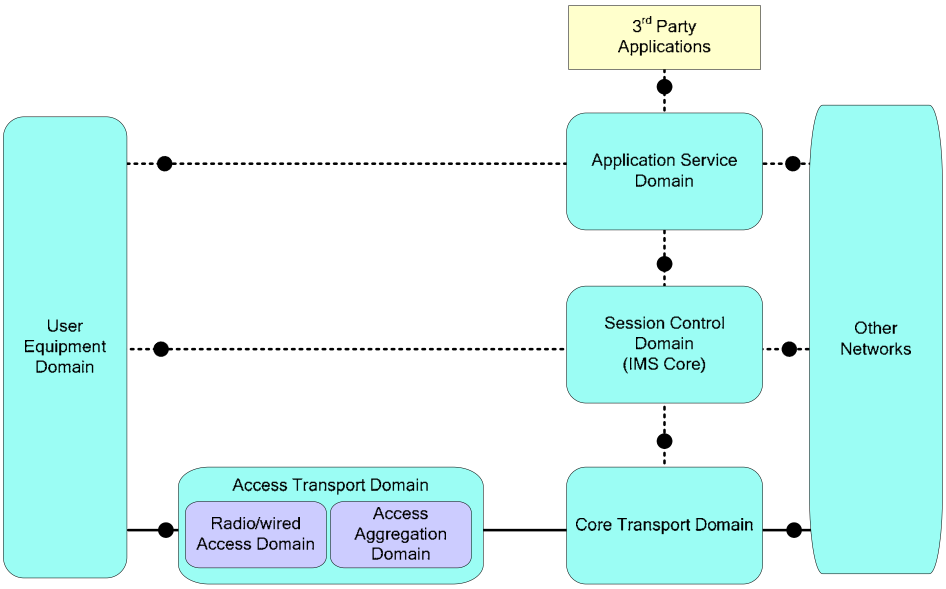


Figure 62 - REC.FMC IMS Based FMC Reference PointsModel

The starting point for fixed mobile convergenceFMC as described in this Recommendation is the use of common Application Service and Session Control Domains for fixed and mobile users. The Session Control Domain is the core part of the 3GPP IP Multimedia System standard Release 7. References to the 3GPP IMS Release 7 documentation can be found in ITU-T Recommendation Q.1741.5. Service convergence including a number of basic FMC service capabilities can be illustrated below by using The use of these common domains and hence of common reference points on fixed and mobile user equipment terminals:to these domains provides service level convergence. It enables a number of basic FMC service capabilities, including:

- access to the same services from different terminals (these may be implemented as a single physical terminal) with different public identities (these may be implemented as a single physical terminal with different public identity),
- -access to the same services from different terminals using the same public user identity; this allows the user to decide which services are directed towards which terminal and in which order, whilst the calling party only needs to know the one public identity.,
- -service continuity on a multi-mode terminal whilst moving between a home or enterprise fixed network environment and the mobile network (e.g. a dual-mode UTRAN and WLAN/Bluetooth handset or PDA that can connect either to a UTRAN BS or to a private WLAN/Bluetooth Access Point that is connected to a fixed network broadband access).

11.2 Convergence point and FMC function

FMC function can be viewed as a network element(s) that controls the points of convergence. The points of network convergence can be different among different network operators depending on the nature of the current networks operated by the service providers (mobile network, fixed network, CS network, PS network etc.). Figure 7 illustrates the three possible points of convergence at different network levels (domains). Please note, the Access Domains for fixed and mobile services are per definition different, although some common components may be shared between mobile and fixed networks. Same applies to Core Transport Domains for mobile and fixed networks.

Service level convergence is illustrated in the middle of figure 72. It may provide service continuity to multi-mode terminals to multi-mode terminals byif the -terminalssuitable capabilities in the terminal and , in the session and application domains have the suitable capabilities. It is essential for service level handover that the terminal supports simultaneous dual-radio interfaces and for the session domain to support multiple simultaneous registrations of the same private identity. In order to support service level handover for a multi-mode terminal independent of the capabilities of the terminal at the other end, an FMC function is required in the application domain that can select between two session legs. i.eI.e. a back-to-back User Agent is required. This point of convergence is most likely adopted by service providers who operate both PS based fixed access and core network as well as PS based mobile access and core network.

Service level mobility management is described in general in draft Rec. MMF. This IMS specific architectural aspects are described in more detail in section tbd.

The alternative architecture to support service continuity to multi-mode terminals is by FMC

functions in a common core transport domain. This is shown on the left hand side of figure 2.

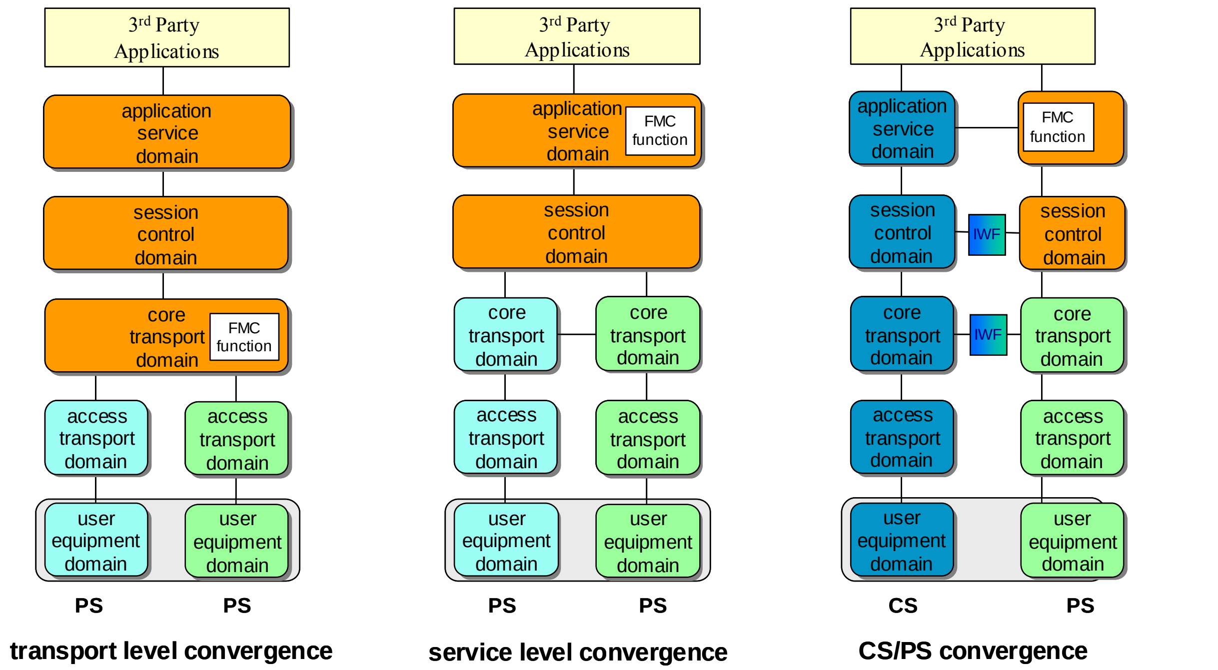


Figure 7~~2-:~~ Convergence ~~types~~ point and FMC function~~s~~

The alternative architecture to support service continuity to multi-mode terminals is by FMC functions in a common core transport domain. This is shown on the left hand side of figure 7. This point of convergence is most likely adopted by operators who own access-agonistic common core networks. In this case, t~~T~~he FMC function in the core transport domain ~~takes care of~~presides over the handover between access domains and the associated network attachment and QoS contexts. If the target access domain can provide the same QoS as the current serving access domain the session control domain does not have to be involved in the handover. If the QoS of the target network is lower than that originally committed to the session domain, then the session control domain needs to be involved in the handover decision. If the target network offers the possibility to increase the QoS of a session, than the session domain should be informed, because it may be desirable to upgrade the QoS of the end-to-end session depending on the capabilities of the access and the terminal at the other end. Transport level mobility management is described in draft Rec. MMF.

~~Section tbd of this recommendation provides more detail on the interaction with IMS.~~

FMC functionality at the transport level may be combined with the ~~use of~~ FMC functionalit~~ys~~ at the service level. This would for instance be necessary to combine a transport level handover for a multi-mode terminal with the capability to transfer a service (e.g. video) from that terminal to a different terminal with a better display.

~~A combination of all three types of convergence may be applied to also allow for roving between CS and PS domains or to combine handover and service transfer capabilities with Enhanced VPN capabilities across CS and PS domains.~~

~~The Access Domains for fixed and mobile services are per definition different, although the Access Aggregation Domain may use some common components.~~

Transport and service level convergence assume that all services are carried over packet switched access and core transport domains. The transition of all mobile networks to packet based voice service will however take time, and it is therefore of interest to have the ability to provide service continuity for voice calls between PS fixed access domains and CS mobile access domains. The architecture to enable this capability is shown on the right hand side of figure 7~~2~~. Interworking between CS and PS domains is provided by ~~Signalling~~Signaling and Media Gateways. These functions are not specific for FMC, because they are required anyway for terminals on both networks to communicate with each other. The FMC specific function in the application domain is able to support two separate call legs, one in the CS domain and the other in the PS domain and select the appropriate domain based on user and/or operator preferences. This scenario is most likely adopted by service providers who operate both CS based mobile network and PS based fixed network.

A combination of all three types of convergence illustrated in figure 7 may be applied to also allow for roaming between CS and PS domains or to combine handover and service transfer capabilities with Enhanced VPN capabilities across CS and PS domains.

In summary, the IMS based FMC architecture is based on the following principles:

– the architecture shall provide access to IMS based services from any type of user equipment with IMS compatible interfaces,

– the user equipment may be connected to any type of packet based Access Transport Domain with compatible interfaces that ~~is~~ are able to convey the protocols between the user equipment and IMS transparently,

– Access Transport Domains may be connected to an access technology independent Core Transport Domain, which implies that the interfaces between access and core are the same regardless of the access technology,

– the interfaces between the Core Transport Domain and the IMS service platform shall be based on the required functionalities~~y~~ to support IMS-based services and capabilities; this does not preclude the use of other service platforms that support this interface,

– the interfaces shall support sharing of Access and Core Transport Domain facilities by multiple service platform providers.

12 Service level convergence between PS domains

As the common objective for both end users and service providers is to achieve service convergence, i.e. seamless and boundaryless services, this section therefore is dedicated to the discussion of this topic.

The convergence architecture in this section assumes different PS domains with the same control interfaces at boundary B defined in section 7. Service continuity across domains is provided by FMC functionality at the service level.

12.1 Motivation

There are two main aspects that motivate the use of service level convergence:

– The user's demand to always benefit from the highest possible performance/cost ratio in any given network environment,

– The operator's desire to optimize the allocation of network resources, extend services to new network environments and diversify the service portfolio.

While transport level handover technologies (such as Mobile IP) can provide continuity of network attachment, they lack the ability to dynamically adapt the services to the network conditions. The reason is that service provisioning depends on a number of aspects that cannot be controlled at the transport level, such as user preferences and inter-operator service agreements. Also each service has its own specific parameters, for instance the video quality and frame rate of real-time video transmission may need to be adjusted to fit into a given bandwidth. Service level convergence is able to take these aspects into account.

12.2 Constraints

The service level cannot perform transport level tasks like controlling and monitoring radio signal strength, attachment and detachment to network access points and IP address configuration. Therefore, to be independent of specific access transport technologies it must rely on either the User Equipment to provide information on the transport level conditions through signalling at the service level, i.e. SIP signalling in the IMS context or on an information service that collects such information from the access networks.

The former method requires the UE to frequently activate its radio interfaces, scan for potential access networks and perform radio measurements on these networks. If the scanning is performed infrequently it poses inherent delay in the handover operation, whilst frequent scanning will increase power consumption. To ease the burden on the UE to achieve access independent handover, the Media Independent Handover (MIH) architecture that has been elaborated in IEEE 802.21 [3] may be applied in conjunction with service level handover control. The MIH information service provides means to supply information on the wireless access networks and their available capacity and costs to the service level control function. Based on location information from the UE, the service level control function can then decide if there are any access networks in the vicinity of the UE that provide a better match for the preferred service profile.

A basic assumption for fixed mobile service level convergence is that fixed and mobile network interfaces can be active simultaneously. This is obviously the case for service transfer from one terminal to another. In case of multimode terminals it is also possible for terminals that e.g. can operate both a WLAN radio to access a fixed WLAN Access Point as well as high-speed radio access to a mobile base station at the same time. This so-called Dual-Radio operation is however not always possible between high power mobile radios, e.g. between different 3GPP radios. Service level handover schemes that take advantage of Dual-Radio operation are therefore not generically applicable between mobile access networks and would need to be enhanced for Single-Radio operation.

An obvious limitation of IMS service level convergence is that it is per definition limited to IMS based services (services delivered via SIP User Agents that are IMS compliant). UEs that do not support IMS signaling cannot take advantage of service level handover control.

12.3 Service Level Convergence Functions

The functions that are involved in service level convergence are shown in figure 11.3-1. Two new functions are introduced in the architecture: The FMC Application Server and the MIH Information Server (MIIS).

The FMC application server may support both service transfer between terminals as well as service level handover for multi-mode terminals. For ease of description the following only refers to the latter.

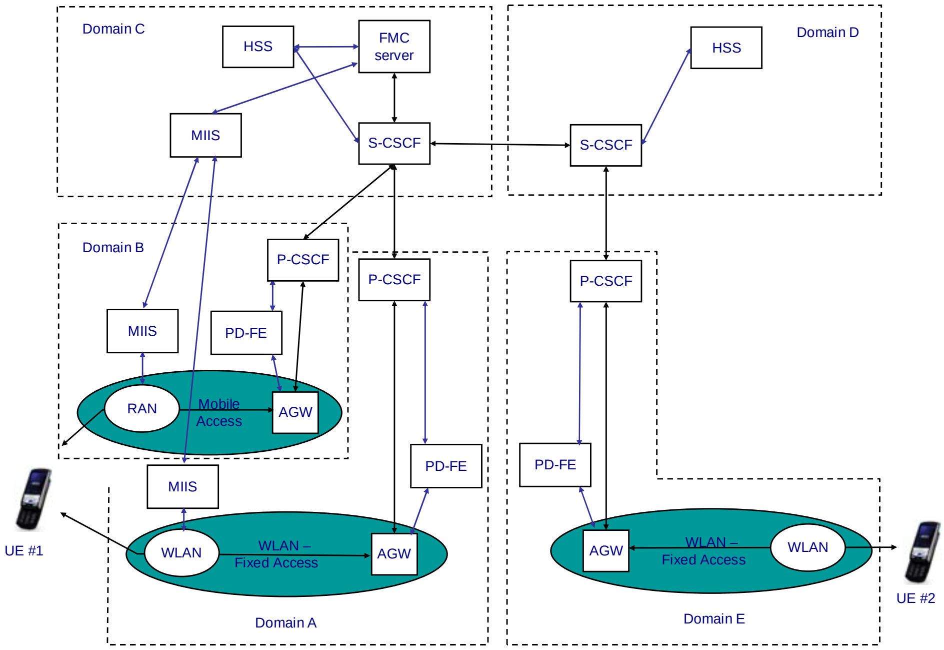


Figure 8 - PS – PS Service Level Convergence Architecture

The figure shows the general case of a UE #1 (on the left hand side of the figure) that is within the radio coverage of both a Visited WLAN access network as well as a Visited Mobile access network, while the access network handover is controlled by an FMC application server in its Home Network. For simplicity the figure shows the scenario where only the originating terminal (UE #1) is a dual mode terminal under service level control. In this scenario the terminating UE #2 has broadband WLAN access, but the service session bandwidth is constrained by the lower bandwidth of the mobile Radio Access Network to which UE #1 is connected. UE #1 may have indicated a preference for a video call with UE #2, but will only get an audio call due to this constraint. When the FMC application server learns that UE #1 has moved to a location where it can be provided with broadband fixed access, it will initiate a handover. The scenario can be extended to the case where also the terminating UE is provided with service level control through an FMC application server in its home network. The originating FMC application server, by subscribing to network context information of the terminating UE from the terminating FMC application server, may then optimize the end-to-end session according to both user's service preferences.

The FMC application server performs the following functions:

– collects information from the HSS on the user's profile and the operator's policy and charging model,
– receives information from the UE on the user's preferences for a session, based on a user defined policy,
– receives information from the UE on the UE location e.g. in the P-Access-Network Info of SIP messages that convey information about the radio access technology and e.g. the radio cell identity

- obtains information from the MIIS (see below) in its domain on available access networks for the UE,
- applies operator policies to the information received and may initiate handover accordingly,
- executes the handover using third party call control.

The MIH Information server collects information about available access networks and capacity and may also provide cost information. It is depicted in a hierarchical arrangement where the MIIS in the IMS home domain of the User can collect access network information from other MISSs in visited domains. Each MISS may collect information from one of more types of access networks in its domain.

Other functions that need to be enhanced to support service level handover are:

S-CSCF:

- shall support multiple registrations from the same UE (same Private Identity)
- will forward SIP messages to the FMC application server according to standard IMS procedures

UE:

- already provides location information in the P-Access-Network-Info, but this may be enhanced with the most accurate location information that the UE has available e.g. geographic location information based on GPS .
- shall be able to transmit and receive data on both its interfaces simultaneously
- should be able to select and order data when it temporarily receives the same data on both its interfaces in order to support seamless operation

12.4 Roaming aspects

Figure 8 depicts five network domains. Each domain may belong to a different network operator. Domains A, B, C and E could however also be part of the same operator's network, in which case domain D is not applicable. Domain C belongs per definition to the Home Service Provider of the UE #1 on the left hand side of the figure to which the FMC handover service is provided. Both A and B may be Visited networks, or either one could be part of the Home Service Provider network. In other words the Home Service Provider may either be a fixed or a mobile operator or both.

As the handover procedure is based on SIP signaling between UE and the FMC server it can be supported by the regular roaming interfaces for IMS services.

12.5 Co-existence of Service level and Transport level handover

In cases that service continuity is achieved by transport level mechanisms, e.g. through Mobile IP, and the mobile and fixed access provide equivalent QoS (bandwidth, delay, packet loss) the transport level handover can be transparent to the service level. In case the QoS of both accesses is substantially different, the service level needs to be involved in the handover decision process. Providing the service level with full control of the handover process as described above offers the advantage that the service that is provided to the user can continuously be optimized for the access network conditions.

~~10~~13 Architecture of the current network

The section provides information on the architectural aspects of existing fixed and mobile networks. The architecture of current networks is analyzed to highlight the architectural aspects and interfaces that are relevant ~~for~~ to IMS based FMC in this recommendation.

~~10.1~~13.1 Mobile network

~~10.1.1~~13.1.1 3GPP

An overview of the 3GPP mobile network architecture can be found in TR 23.882 V1.0.0 and is reproduced below. The figure represents the 3GPP release 6 architecture with the exception of the PCRF that is a release 7 component that replaces the release 6 PDF.

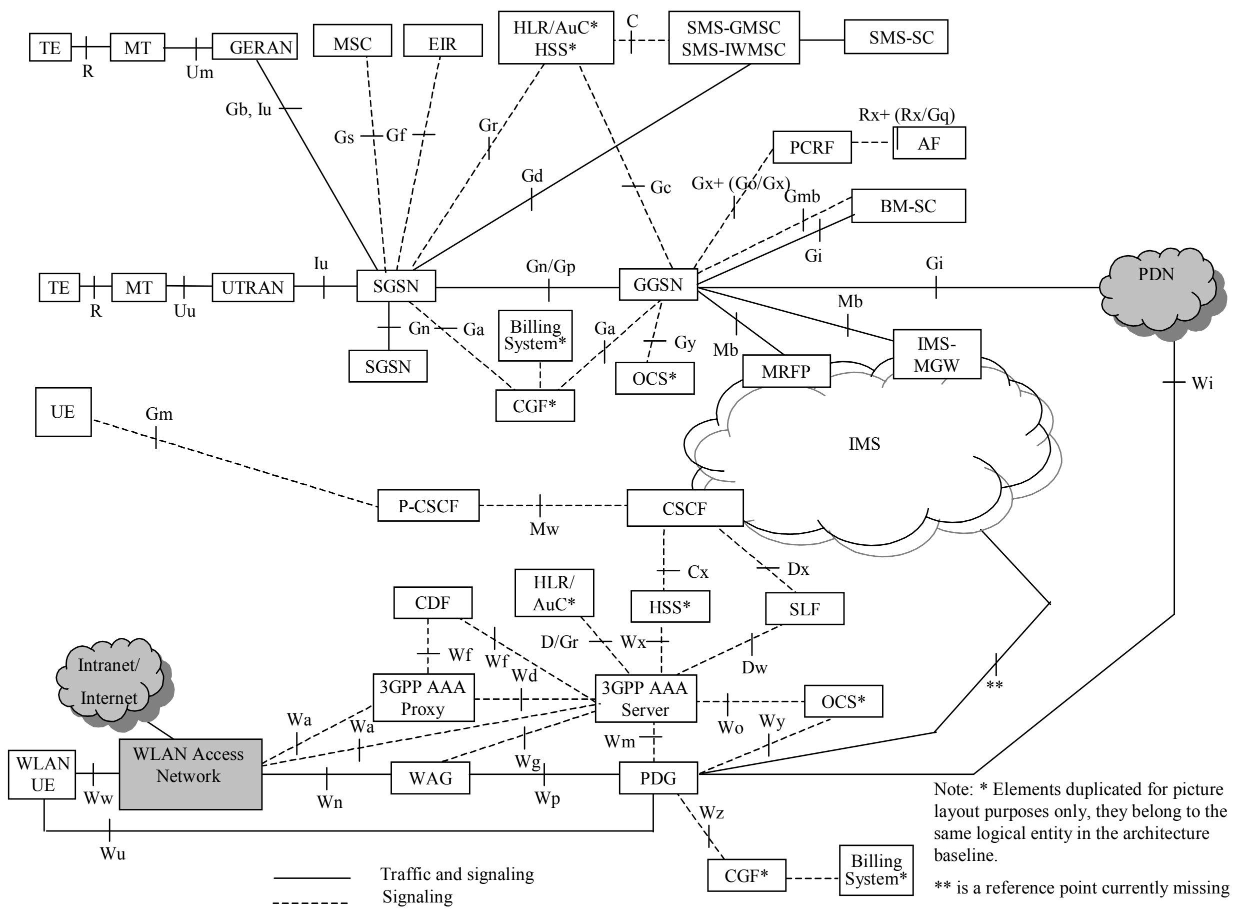


Figure 9~~3~~ - TR 23.882 ~~Figure 4.1-1.~~ Logical baseline architecture for 3GPP

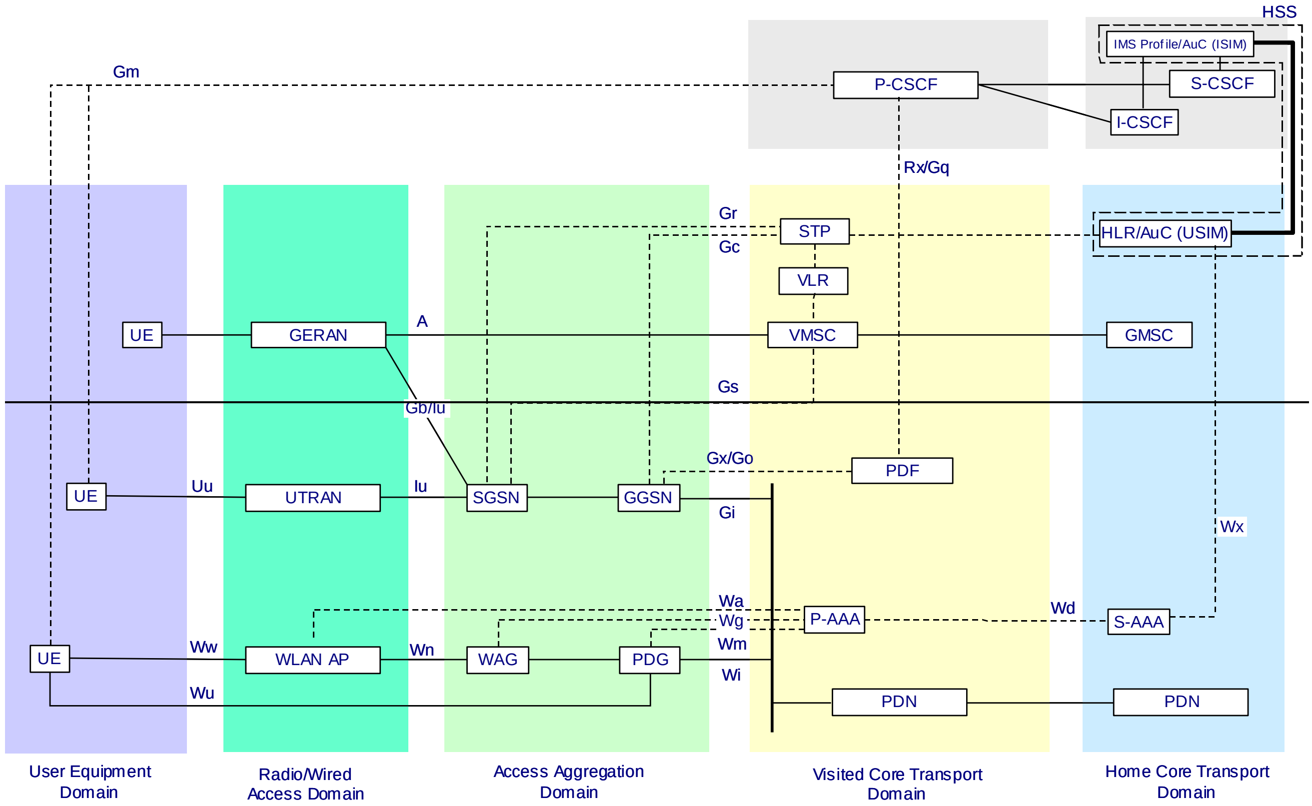
The figure depicts the three different types of accesses that have been defined by 3GPP: GERAN, UTRAN and I-WLAN. GERAN was originally designed to interface to a 2G core network through the A-interface for voice and the Gb-interface for data. Subsequently the Iu-interface has been introduced for GERAN, in order to allow GERAN to be connected to a 3G core network.

In 2G networks voice is carried over the circuit switched A-interface. In current 3G networks voice is pre-dominantly carried over the circuit switched Iu-cs interface, although the standards are in place to support voice and conversational services over the Iu-ps interface. Optimization of GERAN to also carry conversational services in packet mode is being studied.

3GPP has defined two types of WLAN access: 3GPP IP access and Direct IP Access. WLAN 3GPP IP access provides access to the 3GPP core network via an IPSec tunnel between WLAN UE and PDG (see figure above). Direct IP access provides access to an IP network directly from the WLAN without passing data through the 3GPP core. 3GPP core functions are however used for authentication and authorization of the access to the WLAN and the locally connected IP network (e.g. Internet).

A mapping of the 3GPP architecture ~~on~~ to the FMC ~~domains of clause 7.2~~reference model is not straightforward, because many deployment scenarios exist in current networks. In 3GPP GPRS is considered to be part of the IP-CAN (IP Connectivity Access Network) from an IMS perspective as well as part of

the 3GPP Core Network from a RAN perspective. From an FMC perspective GPRS appears to be a 3GPP specific access aggregation network, including intra-access mobility management functions. In the figure below we have depicted a mapping of the 3GPP entities on the FMC domain model with a split of the Core Domains in a Visited and a Home Domain. In practical deployments the access and visited domains are within a single operator domain



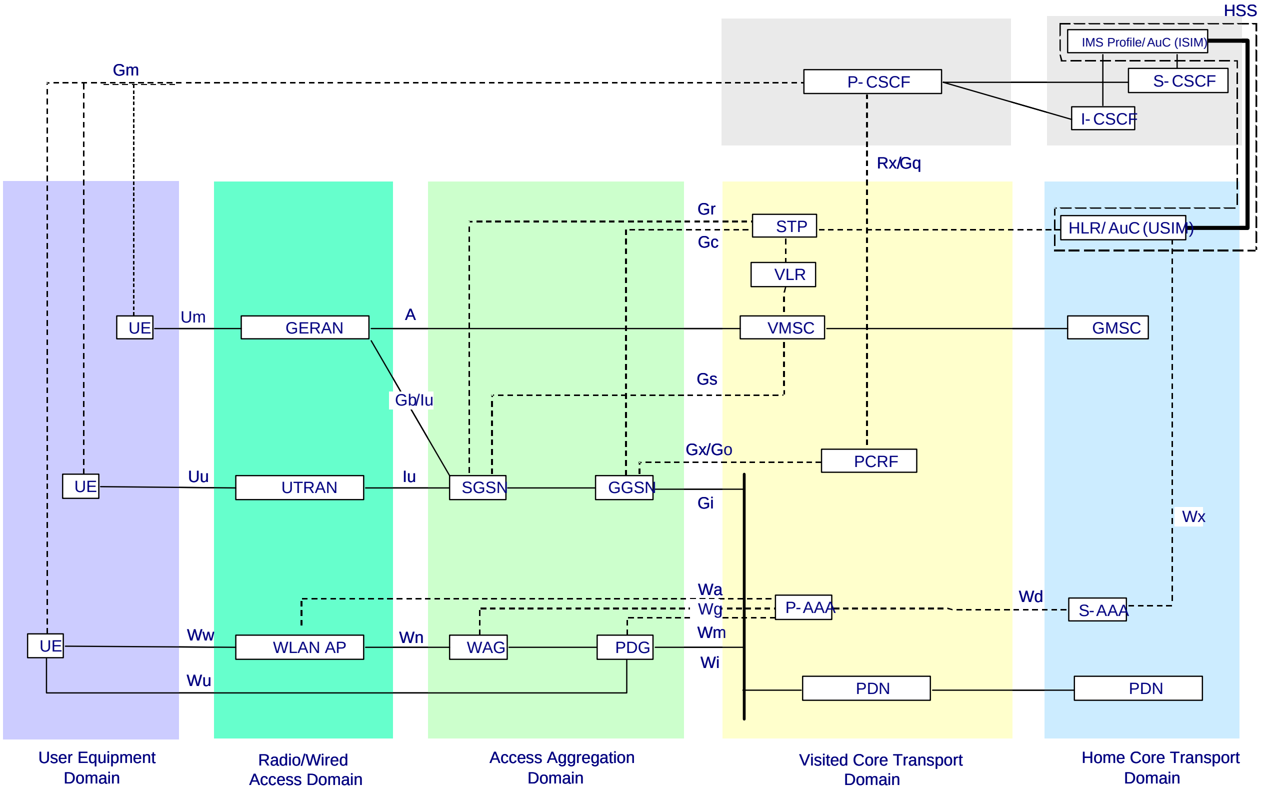


Figure 10~~4~~ – Mapping of 3GPP architecture ~~on~~ to IMS based FMC ~~domains~~reference model

As described in section 9~~7.3~~, the long term architecture for FMC is the NGN architecture, where the Core Transport Domains are access independent. The implication of the mapping ~~of~~ depicted in figure 9~~2~~ is that the 3GPPP PS domain components that are mapped on the FMC core transport domains are candidates to evolve to a common role for both 3GPP and non 3GPP accesses. This implies that the interfaces to the Session Control Domain will also be common. It should be an objective to define common interfaces to the access domain as well, but these will only be applicable for new access systems.

~~10.1.2~~13.1.2 3GPP2

3GPP2 network architecture is very similar to the 3GPP network architecture. In fact 3GPP2 has adopted the 3GPP IMS standards since 2006. The diagram below illustrates the MMD network architecture defined by 3GPP2:

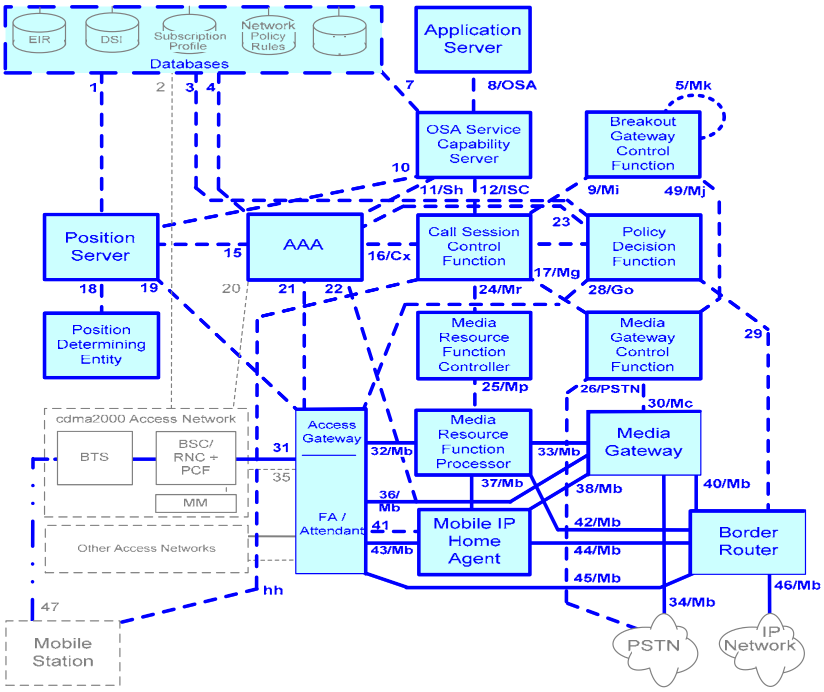


Figure 11 - 3GPP2 X.S0013-000-A MMD Network Architecture Model

The mapping of 3GPP2 network on FMC domains is illustrated below. For comparison, only the relevant components are included.

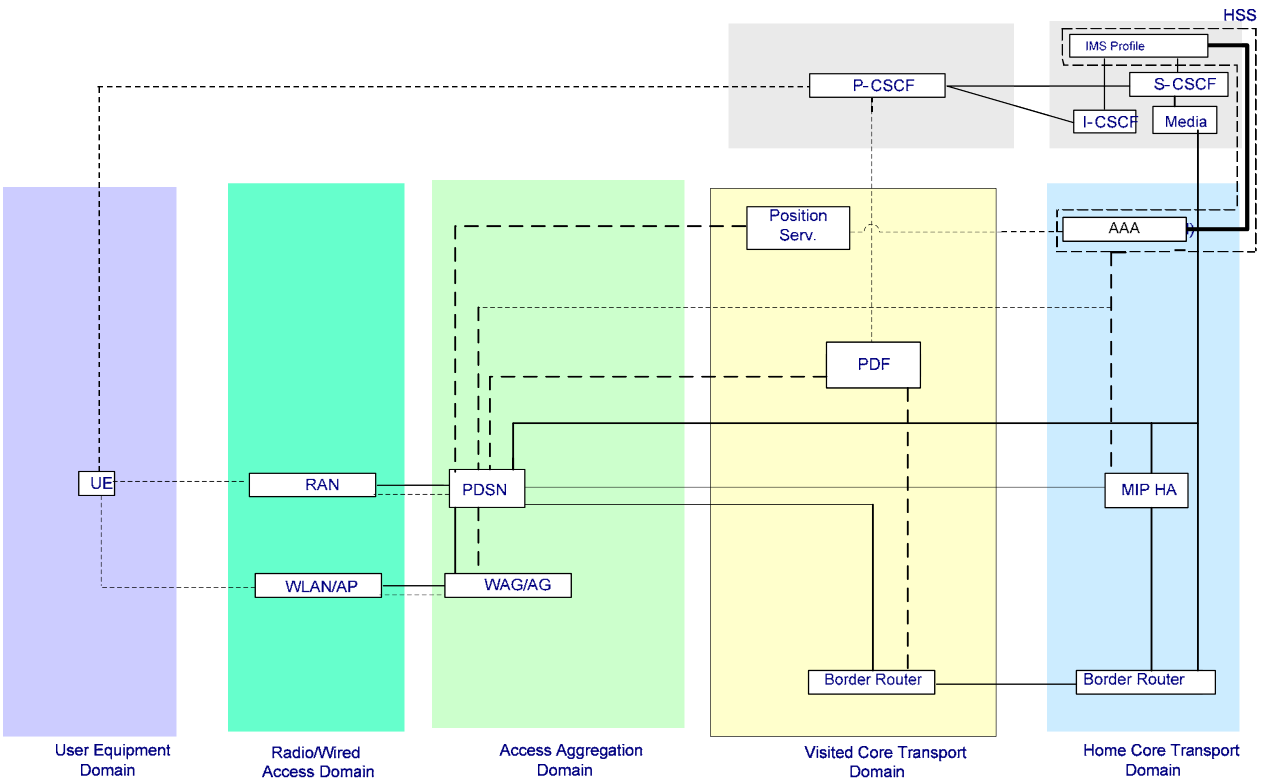


Figure 11 – Mapping of 3GPP2 architecture (with home routed traffic) to IMS based FMC reference model

~~To be added.~~

~~10.2~~13.2 Fixed network architecture

SIP-based IMS platform was originally developed for IP based 3GPP/2 networks. ITU-T and ETSI have selected the SIP-based IMS platform as the NGN platform for ~~this purpose,~~the convergence of telecommunication and internet. ~~which was originally developed for IP based 3GPP/2 networks.~~

The ETSI TISPAN architecture of the evolved fixed network is depicted in the figure below:

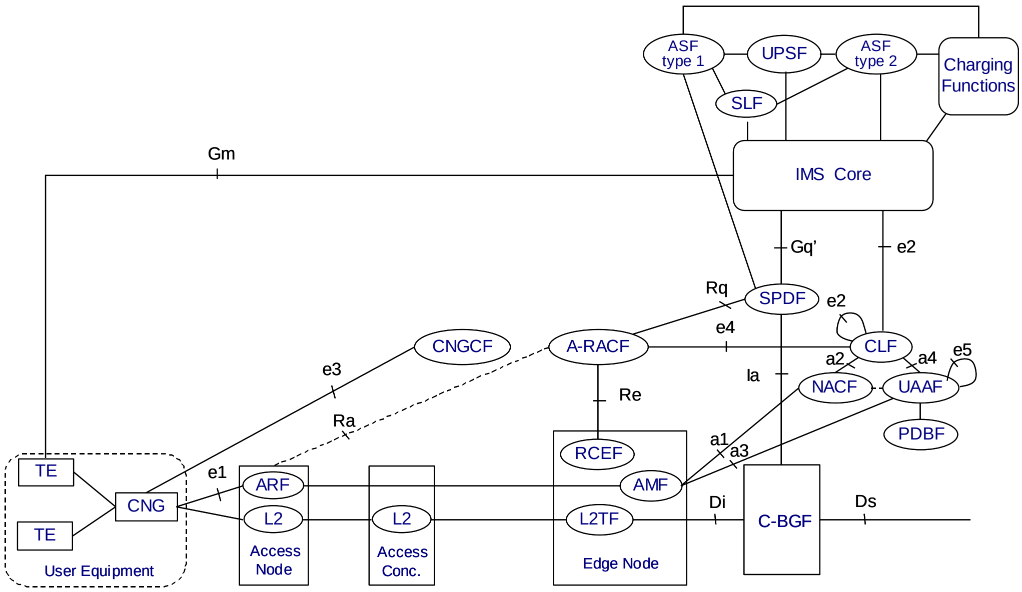


Figure 12~~5~~ - TISPAN Functional Architecture

A ~~tentative~~ possible mapping of the TISPAN functional architecture on the FMC domains is shown in the next figure. It should be noted that support of nomadicity and roaming for different deployment scenarios is further elaborated ~~for~~ in TISPAN R2.

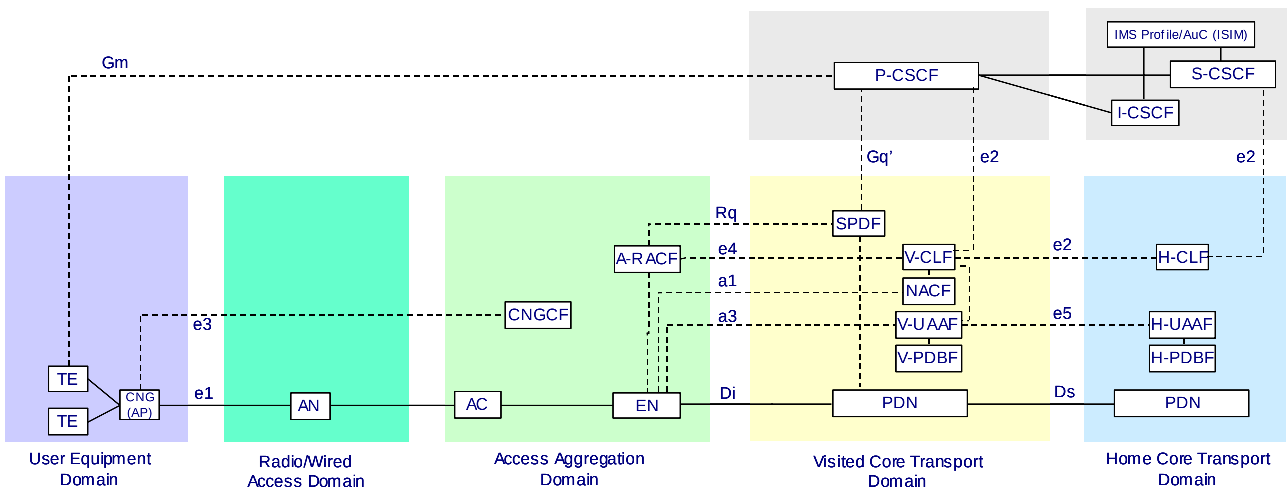


Figure 13~~6~~ – Mapping of Functional Architecture ~~on~~ to IMS ~~domains~~based reference model

The functions that are relevant from an FMC common core perspective are in the Core Transport Domains. Compared with the 3GPP architecture the TISPAN architecture provides a more detailed functional decomposition, which however it complicates the identification of common functions and interfaces. This is further analyzed in section 10.

Editor's note: Further study is needed to map the figures above on versions based on FRA components. FRA is currently lacking a roaming model.

Include the DSL Forum architecture?

1114 Converged network architectures

The section provides information on the architectural aspects of existing converged network architecture. The current architectures are analyzed to highlight the architectural aspects and interfaces that are relevant to draft rec. Q.IMS-FMC.

There are different ways to provide FMC capabilities, determined by the location of convergence functions in the overall NGN architecture. Those aspects are highlighted in the following diagram:

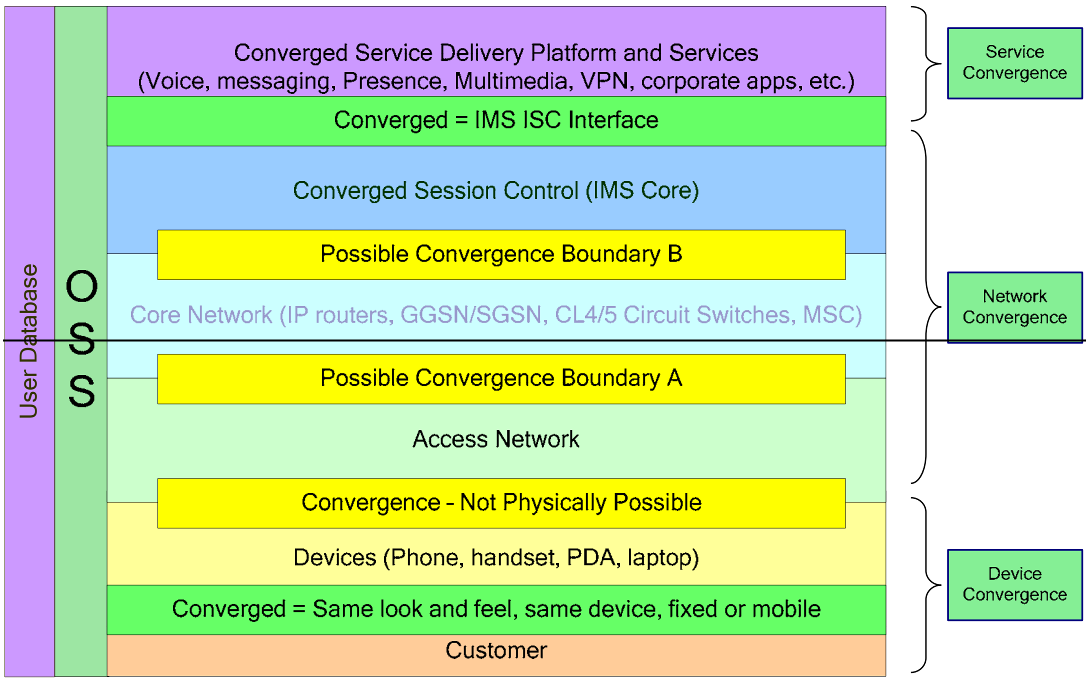


Figure xxx Different potential convergence boundaries

From the network control perspective, with IMS as session control, there are two potential boundaries for convergence. One is at the boundary between the core network and the session control domain (possible convergence boundary B). The other possible convergence boundary is between the access network and the core network (possible convergence boundary A)

11.1UMA/GAN based convergence

The UMA/GAN based convergence explores the possible convergence boundary A in the above diagram (figure xxx).

The first – mobile centric – FMC architecture that has been developed by the industry to provide service continuity for a multi-mode WLAN/2G terminal when it changes its point of attachment is known as Unlicensed Mobile Access (UMA). Demand for such capabilities is driven by competition on price and user convenience and the desire to extend service coverage in buildings with poor mobile radio reception.

UMA is fully specified by 3GPP as Generic Access Network (GAN). The architecture is depicted in the figure below:

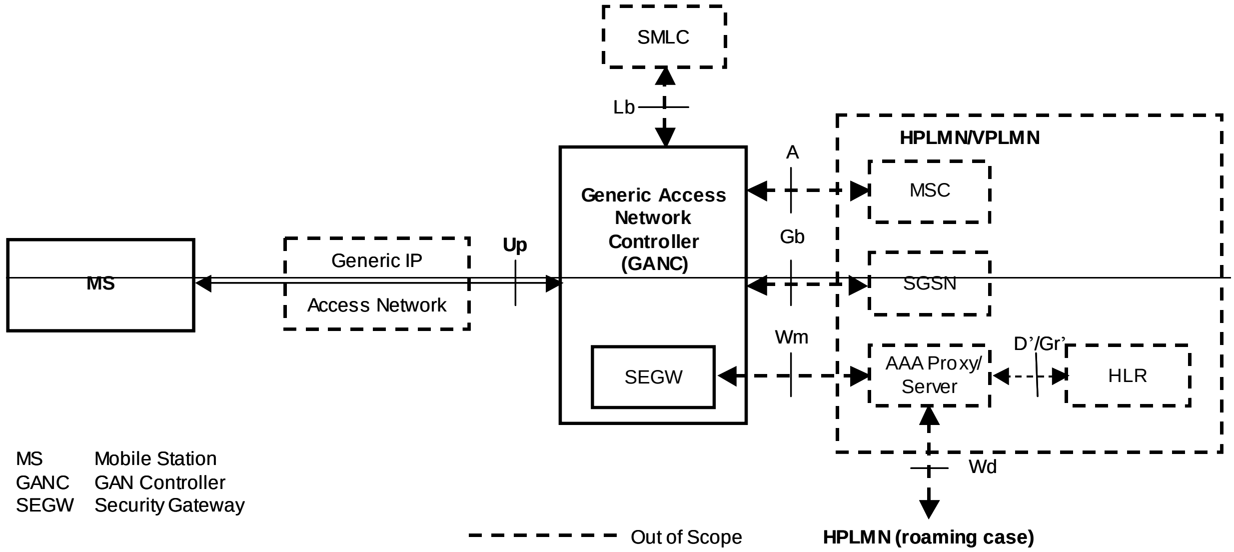


Figure 7 – TS43.318v2.0.0 figure 4.1 GAN functional architecture

It assumes that the UE is connected to the 3GPP CS/PS domain via a GAN Controller (GANC). The GANC appears to the 3GPP core network as a GERAN Base Station Subsystem (BSS). The GANC terminates the IP connection to the WLAN UE and provides an A interface to the MSC for CS services and a Gb interface to the SGSN for PS services. The solution provides for handover of voice calls between GERAN and GAN access to the 3GPP CS domain. Note that voice calls remain in the CS domain. Indirect handover between UTRAN and GAN is also supported. UTRAN treats the GAN cell as a GERAN cell in this case.

UMA/GAN offers a pragmatic solution for mobile operators with an embedded CS network to extend their coverage using WLAN. It does not provide an evolution path to an all-IP NGN, since it keeps voice calls in the CS domain.

14.1 Combining Circuit Switched and IMS services (CSI)

There is specification work underway in 3GPP on the combination of Circuit Switched and IMS services (CSI) and this will allows IMS services to be extended to a terminal on a GAN access. See TS 23.279 for details. This is a rather circuitous way to provide IMS services to a fixed access compared to the fixed network architecture described in clause 7.5.2section 9. The latter is therefore the recommended evolution path for the fixed access part of a WLAN/2G fixed mobile convergence solution, in combination with the Voice Call Continuity (VCC) architecture described below.

11.214.2 Voice Call Continuity (VCC) based convergence

The VCC based convergence explores the possible convergence boundary B in the above diagram (Figure xxx)defined in section 7.

Voice Call ContinuityVCC is an alternative – IMS centric – approach to provide service continuity for voice calls when a multi-mode WLAN-SIP/2G-3G-CS terminal changes its point of attachment. It's considered being the key organic IMS application. VCC provides the capability to transfer the path of a voice call between a CS and a PS-IMS domain. It assumes that the UE is capable of supporting two separate call legs related to the same voice communications (one over the CS domain and the other via the IMS domain). The approach for the first set of VCC specifications (part of 3GPP release 7) is static anchoring of all voice calls in the IMS of the user's home network.

VCC The architectural solution provides completely automatic connectivity from the end-user point of view. The most appropriate network domain (i.e. mobile CS domain or IMS domain) to serve the user is selected based on a combination of user and operator defined policies.

The VCC reference architecture defined in TS 23.206 by 3GPP is depicted in the figure below:

Editor's note: The 3GPP VCC architecture described in figure 14 is not directly applicable to 3GPP2 due to architectural differences.

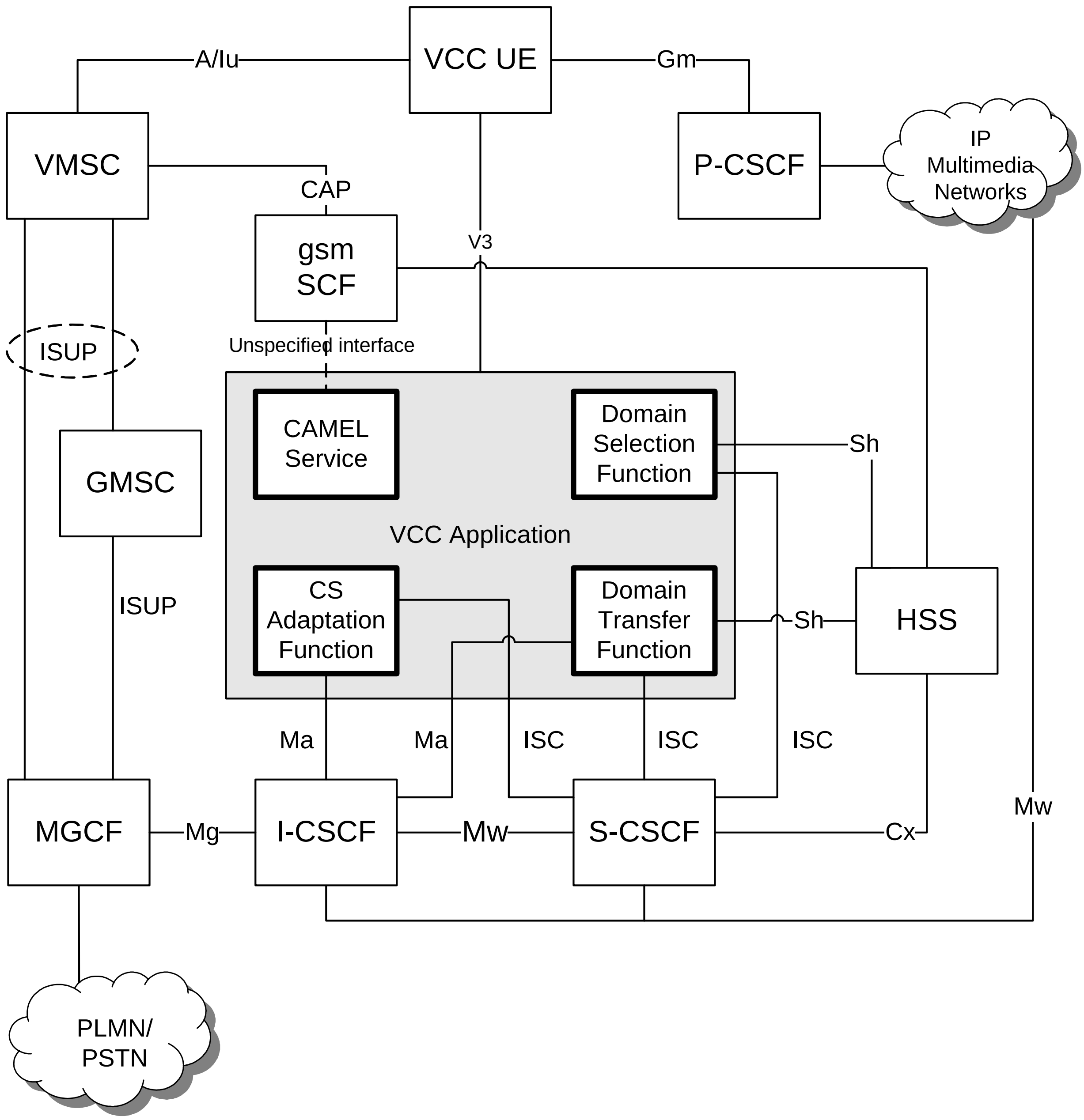


Figure 14 – TS23.206 VCC reference architecture

The VCC Application is implemented as an IMS application server. It controls the establishment of call legs required to transfer a call between a CS and PS domain. UEs have to register with both IMS and CS domains in order to realize the VCC functionalities. After IMS registration according to the regular IMS procedures information can be exchanged between the VCC UE and VCC Application (VCC AS).

For calls originating in the IMS domain initial Filter Criteria for the user result in the routing of the IMS originating sessions to the VCC-AS in the home IMS network, where the VCC AS uses 3rd party call control to initiate a call to the remote party on behalf of the user. For calls originating in the CS domain CAMEL service triggering is used at the VMSC towards the gsmSCF function. The VCC AS returns routing information to the VMSC, which is used by the VMSC to route the call towards an MGCF in the user's home IMS network. The VCC Application terminates the incoming leg towards the intended called party by acting as a Back to Back User Agent (B2BUA).

For terminated calls coming from the IMS domain the VCC AS is invoked. It selects the terminating network as part of the termination service logic for the user. If the call is to be terminated in the IMS domain, the VCC AS acts again as a B2BUA using 3rd party call control to establish a normal IMS session setup towards the terminating VCC UE. If the call is to be terminated to CS domain, the VCC AS determines the CS domain Routing Number (CSRN), optionally in collaboration with HSS. For calls coming from the CS domain it is necessary to anchor the call in the IMS domain. Since this is in the home domain, it is an operator decision how the anchoring is achieved. CAMEL triggering could be used, but other methods like dedicated trunk groups at the GMSC or the use of a local number portability database are also possible. Possible options are documented in TS 23.206.

The routing of terminating calls is depicted in the figure below.

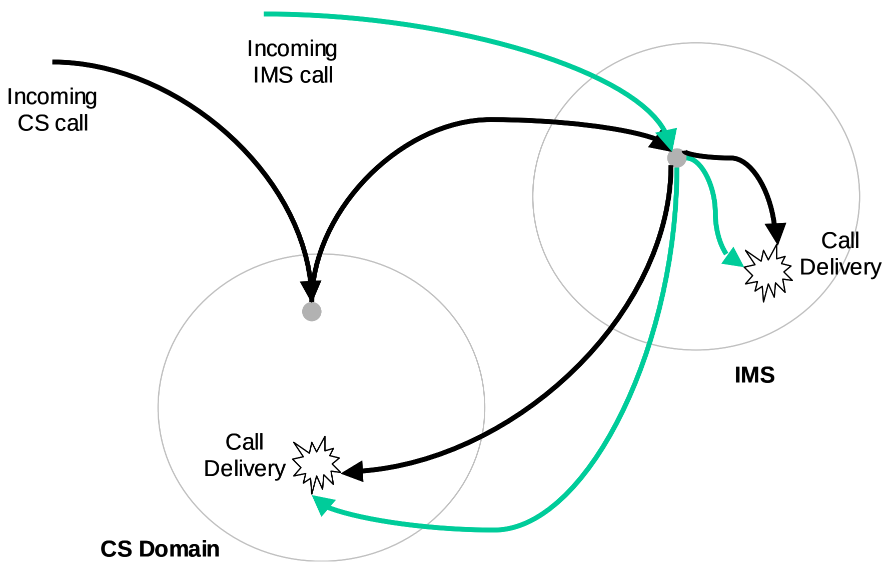


Figure 14 – **VCC call termination**

Domain transfer is initiated by the VCC UE based on the predefined conditions requiring transfer. For a transfer from a CS to a PS-IMS domain the UE sends an SIP INVITE to the VCC AS to initiate the transfer procedure. For a transfer from a PS-IMS to a CS domain the UE initiates a CS call towards the VCC AS. The VCC AS performs the transfer of IMS leg to CS using SIP Session Transfer.

The bearer path interruption due to the switchover is estimated to be in the 100 – 200 ms range.

The VCC architecture defined in TS23.206 (3GPP Rel. 7) and illustrated in figure 13 has its limitations. When domain transfer takes place, because of the call is not implemented in both domains, certain calls, such as calls that involved in the conference or multi-party services may be interrupted. Domain transfer may not be supported for voice sessions with mid call services before the anchoring being taken place. To address these limitations, alternative approaches, such as Centralized IMS Services (TR 23.892) are under study in 3GPP release 8.

Editor's note: A mapping of the 3GPP VCC architecture on the FMC domain model needs to be added.

~~A summary of the 3GPP release 7 architecture can be found in annex .~~

14.3 3GPP Evolved Packet System based Convergence

The architectural evolution of 3GPP mobile networks is referred to as the Evolved Packet System, consisting of an Evolved Packet Core (EPC) and an Evolved UTRAN radio access network. The EPC is designed to connect other 3GPP accesses also, as well as non-3GPP accesses, currently the subject of a feasibility study in 3GPP SA2. The objectives of the study 3GPP network evolution are not only to provide higher data rates and lower data and control plane latency, but also to provide service continuity between the I-WLAN and 3GPP PS domain and terminal mobility between different access networks in general, continuity within and between 3GPP access networks and between 3GPP and non-3GPP accesses. The figure 15 below shows the high level architecture for the evolved 3GPP system for the non-roaming case.

To satisfy the large variety of network environments of mobile network operators, the EPS architecture has two variants. The first one, documented in TS 23.401 is an evolution of the current GTP based architecture and retains the GTP model of 2G/3G mobile networks for network based intra 3GPP mobility. This model uses tunnelling over IP for mobility management and also to create QoS tunnels that are mapped 1:1 to radio bearers in the 3GPP radio access networks. Two levels of mobility are defined in the EPS. The global mobility anchor is called a Packet Data Network (PDN) Gateway and the network that connects a mobile network to the PDN GW can be considered as a virtual layer 2 access network. In case of roaming with home routed, the layer 2 network is extended to a PDN GW in the network of the home operator and can be considered as an access network from the perspective of the home operator.

Other functional entities in the EPS architecture are the Serving Gateway (SGW) that provides a local mobility anchor as well as the anchor point for intra 3GPP mobility. The Mobility Management Entity (MME) is a control plane node that supports mobility management and related functions such as idle mode tracking and paging and acts as a proxy for authentication and also for QoS signalling. The Policy and Charging Resource Function (PCRF) is responsible for dynamic policy control and supplies QoS policy information together with charging rules for aggregated IP flows to the PDN GW. The non-roaming architecture as depicted in TS 23.401 is reproduced in figure 15.

The significance of the 3GPP study for FMC is that it includes the connection of a non-3GPP IP access to the Evolved 3GPP Packet Core network, which may be a fixed access network. As is shown in the figure the non 3GPP access network will be connected to an Inter AS Anchor function, so that mobility between the fixed access and a 3GPP could in principle be supported, for instance using Mobile IP.

The evolved 3GPP architecture is mobile network centric in the sense that the 3GPP specific MME/UPE mobility function is depicted as part of the evolved packet core. In a roaming scenario the MME/UPE will be in the visited and the Inter AS Anchor in the home network. It is the latter network that can be mapped on the FMC core transport home domain, and hence the part of the architecture that may contain FMC functions to support FMC on the network layer.

A detailed analysis of the required FMC functions has to wait for a further functional decomposition of the roaming architecture.

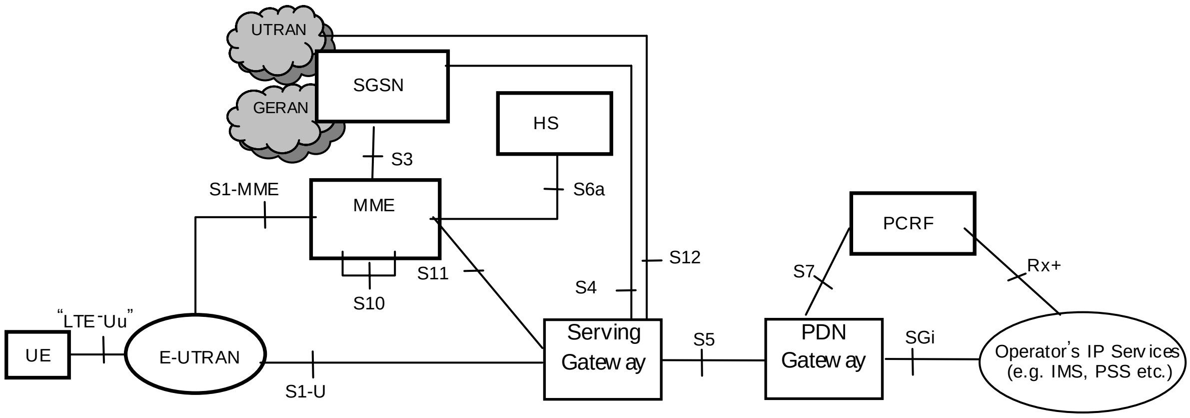


Figure 15 –– TS 23.401 R23.882 Logical high level Non-roaming architecture for the evolved system3GPP accesses

Editor's note: This figure is subject to change and should be replaced by the final version in the published TS.

The mapping of the GTP based EPS architecture is similar to that of the Release -7 architecture shown in figure 9 with the PDN GW replacing the GGSN as the access network termination point.

The second variant of the EPS architecture, documented in TS 23.402, provides a 'global' mobility anchor for both network (PMIP, CMIPv4 FA) as well as host based (DSMIPv6) mobility in the PDN GW. IETF based mobility management is supported towards non-3GPP accesses for compatibility with these accesses. The PDN GW can support mobility between 3GPP and non-3GPP accesses using either network or host based mobility. The 3GPP network interface to the PDN GW (S5) may be either GTP based according to TS 23.401, but may also use PMIP. In the latter case there are no per QoS tunnels on the S5 interface and the QoS signalling towards the Serving Gateway is directly from the PCRF, rather than via the PDN GW.. Figure 16 shows an instantiation of the TS 23.402 architecture with 3GPP as well as non-3GPP accesses. Note the distinction between trusted and untrusted access. For untrusted access it is deemed necessary to run an IPSec tunnel between the UE and a gateway (ePDG) in the operator domain to provide sufficient security for the user. The architecture model in figure 16 shows the use of PMIP interfaces from the PDN GW to all accesses and local breakout (global mobility anchoring) of all traffic in the visited network. Many more deployment options of the TS 23 .402 architecture are possible depending on operator deployment and terminal capabilities, including the use of host based mobility (DSMIPv6) to achieve mobility between 3GPP and non-3GPP accesses.

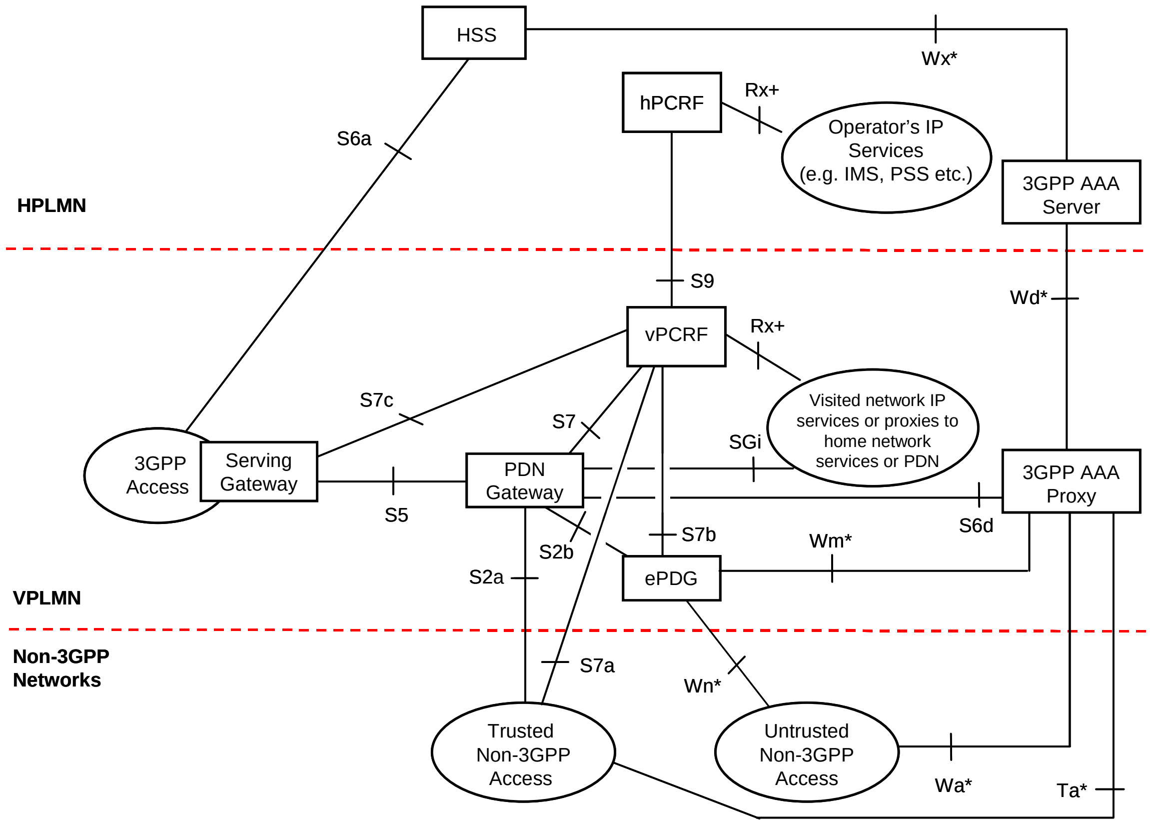


Figure 16 – TS 23.402 Roaming architecture for EPS using S5, S2a, S2b – Local Breakout

Editor's note: This figure is subject to change and should be replaced by the final version in the published TS.

With the TS 23.402 architecture there is no virtual layer 2 on the reference points towards the PDN GW and the access can be considered to be terminated in the SGW or in an equivalent functional entity in the non-3GPP access. The PDN GW may be located in the core network of the visited or home operator. The former case is depicted in figure 16. The mapping of the TS 23.402 architecture of figure 16 on the FMC domains is shown in figure 17 below. For simplicity we have only drawn the case where the IMS P-CSCF is located in the visited network, but as is shown in figure 16, the P-CSCF may also be located in the home network.

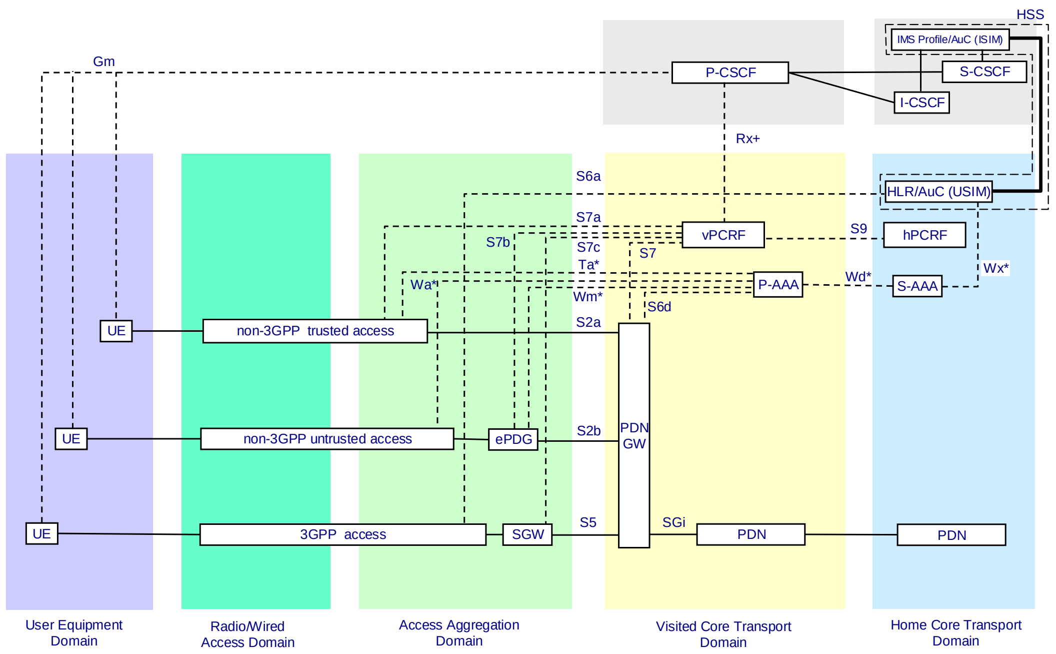


Figure 17 – Mapping of 3GPP TS 23.402 local break-out architecture to IMS based FMC reference model

11.3 Service level convergence between PS domains

This convergence architecture assumes different PS domains with the same control interfaces at boundary B in (Figure xxx). Service continuity across domains is provided by FMC functionality at the service level.

11.3.1 Motivation

There are two main aspects that motivate the use of service level convergence:

- The user's demand to always benefit from the highest possible performance/cost ratio in any given network environment,
- The operator's desire to optimize the allocation of network resources, extend services to new network environments and diversify the service portfolio.

While transport level handover technologies (such as Mobile IP) can provide continuity of network attachment, they lack the ability to dynamically adapt the services to the network conditions. The reason is that service provisioning depends on a number of aspects that cannot be controlled at the transport level, such as user preferences and inter-operator service agreements. Also each service has its own specific parameters, for instance the video quality and frame rate of real-time video transmission may need to be adjusted to fit into a given bandwidth. Service level convergence is able to take these aspects into account.

11.3.2 Constraints

The service level cannot perform transport level tasks like controlling and monitoring radio signal strength, attachment and detachment to network access points and IP address configuration. Therefore, to be independent of specific access transport technologies it must rely on either the User Equipment to provide information on the transport level conditions through signalling at the service level, i.e. SIP signalling in the IMS context or on an information service that collects such information from the access networks.

The former method requires the UE to frequently activate its radio interfaces, scan for potential access networks and perform radio measurements on these networks. If the scanning is performed infrequently it poses inherent delay in the handover operation, whilst frequent scanning will increase power consumption. To ease the burden on the UE to achieve access independent handover, the Media Independent Handover (MIH) architecture that has been elaborated in IEEE 802.21 [3] may be applied in conjunction with service level handover control. The MIH information service provides a means to supply information on the wireless access networks and their available capacity and costs to the service level control function. Based on location information from the UE, the service level control function can then decide if there are any access networks in the vicinity of the UE that provide a better match for the preferred service profile..

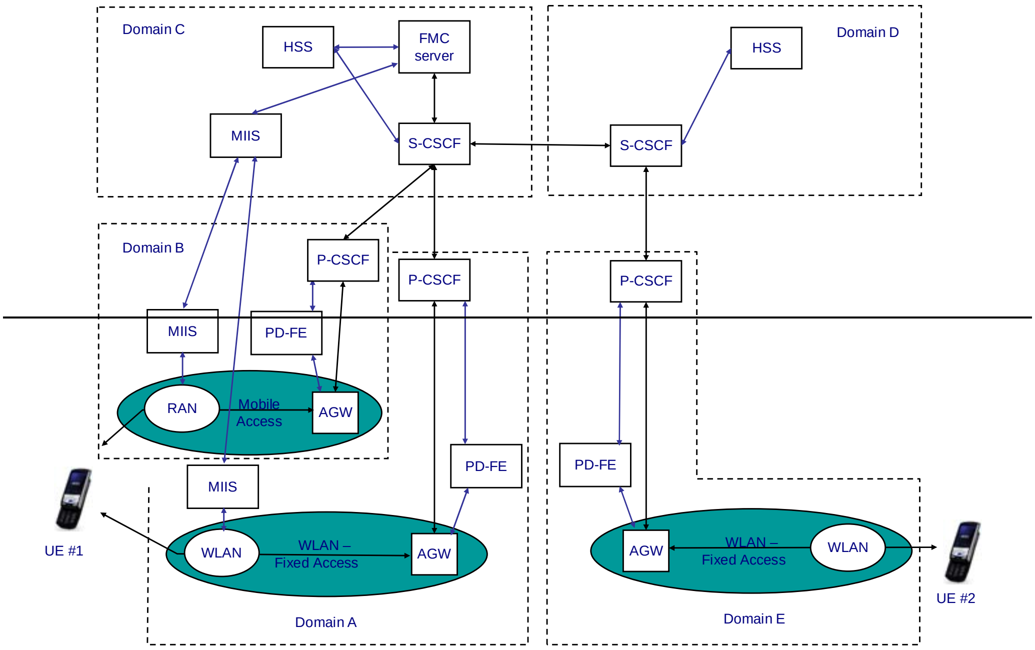
A basic assumption for fixed mobile service level convergence is that fixed and mobile network interfaces can be active simultaneously. This is obviously the case for service transfer from one terminal to another. In case of multimode terminals it is also possible for terminals that e.g. provide can operate both a WLAN radio to access a fixed WLAN Access Point as well as high-speed radio access to a mobile base station at the same time.. This so-called Dual-Radio operation is however not always possible between high power mobile radios, e.g. between different 3GPP radios. Service level handover schemes that take advantage of Dual-Radio operation are therefore not generically applicable between mobile access networks and will would need to be enhanced for this purpose Single-Radio operation..

An obvious limitation of IMS service level convergence is that it is per definition limited to IMS based services (services delivered via SIP User Agents that are IMS compliant). UEs that do not support IMS_ based services are out of scope for this recommendationsignalling cannot .take advantage of service level handover control.

11.3.3 Service Level Convergence Functions

The IMS functions that are involved in service level convergence are shown in figure 11.1.3-1. Two new functions are introduced in the architecture: The FMC Application Server and the MIH Information Server (MIIS).

The only new function that is specific for service level convergence is the The FMC application server. The same application server may support both service transfer between terminals as well as service level handover for multi-mode terminals. For ease of description the following only refers to the latter.



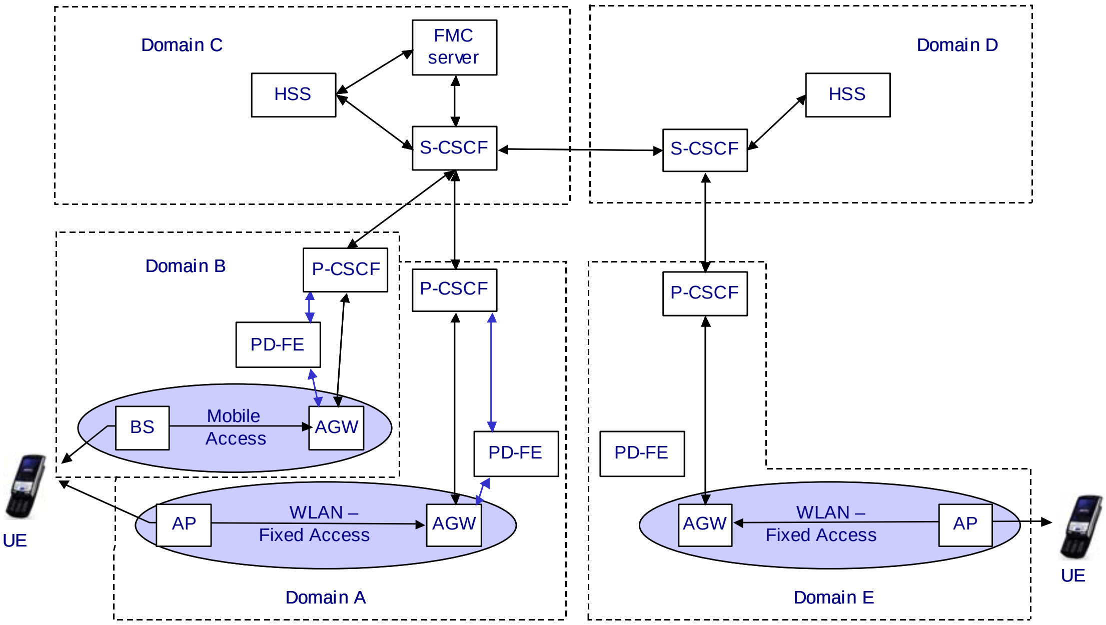


Figure 11.3 11.3 PS PS Service Level Convergence FunctionsArchitecture

The figure shows the most general case of a UE #1 (on the left hand side of the figure) that is within the radio coverage of both a Visited WLAN access network as well as a Visited Mobile access network, while the access network selection handover is controlled by an FMC application server in its Home Network. For simplicity the figure shows the scenario where only the originating terminal (UE #1) is a dual mode terminal under service level control. In this scenario the terminating UE #2 has broadband WLAN access, but the service session bandwidth is constrained by the lower bandwidth of the mobile Radio Access Network to which UE #1 is connected. UE #1 may have indicated a preference for a video call with UE #2, but will only get an audio call due to this constraint. When the FMC application server learns that UE #1 has moved to a location where it can be provided with broadband fixed access, it will initiate a handover. The scenario can be extended to the case where also the terminating UE is provided with service level control through an FMC application server in its home network. The originating FMC application server, by subscribing to network context information of the terminating UE from the terminating FMC application server, may then optimize the end-to-end session according to both user's service preferences.

The FMC application server performs the following functions:

- collects information from the HSS on the user's profile and the operator's policy and charging model,
- receives information from the UE on the user's preferences for a session, based on a user defined policy,
- receives information from the UE on the UE location e.g. in the P-Access-Network Info of SIP messages that convey information about the radio access technology and e.g. the radio cell identity
- receives obtains information from the MIIS (see below) in its domain on available access networks for the UE,
- applies operator policies to the information received and may initiate handover accordingly,
- executes the handover using third party call control.

Annex Atransport network context information from UEs that are subscribed to the service,collects information on the user's preferences, and network costs

- applies operator policies to the information received and may initiate handover accordingly

The MIH Information server collects information about available access networks and capacity and may also provide cost information. It is depicted in a hierarchical arrangement where the MIIS in the IMS home domain of the User can collect access network information from other MISSs in visited domains. Each MISS may collect information from one of more types of access networks in its domain.

Editor's note: The figure needs to be enhanced to show the interfaces of the FMC server to other network functions to obtain information on e.g. SLAs with Visited Networks.

Other functions that need to be enhanced to support service level handover are:

S-CSCF:

- shall support multiple registrations from the same UE (same Private Identity)
- will forward SIP messages to the FMC application server according to standard IMS procedures

UE:

- collects information on network conditions and signals significant changes in these conditions to the FMC server through SIP signaling. An alternative could be to use the Ut interface. This is FFSalready provides location information in the P-Access-Network-Info, but this may be enhanced with the most accurate location information that the UE has available e.g. geographic location information based on GPS .
- shall be able to transmit and receive data on both its interfaces simultaneously
- the peer UE should be able to change the destination IP address of the data select and order data when it temporarily receives it transmits the same data on both its interfaces in order to support seamless operation

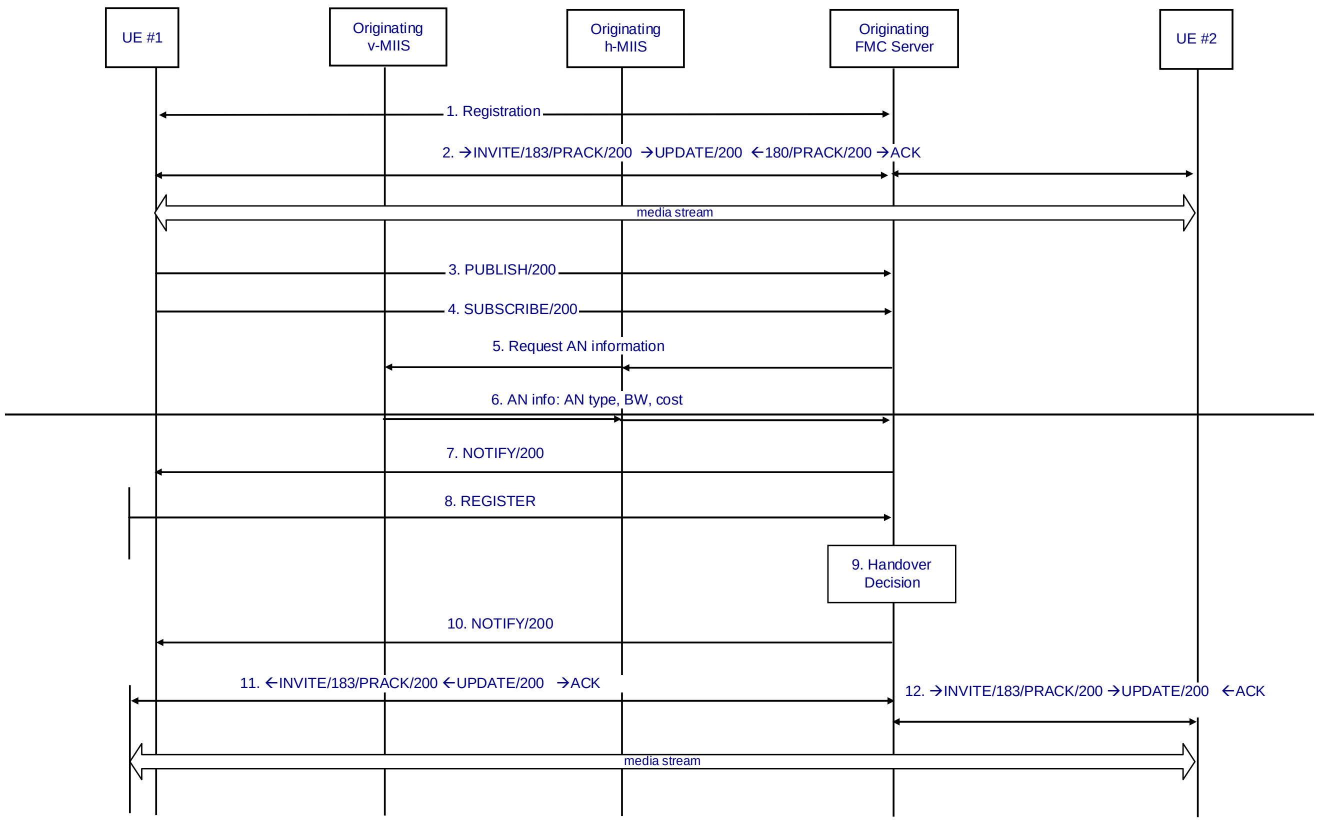
11.3.4 Roaming aspects

Figure 11.1.3_1 depicts five network domains. Each domain may belong to a different network operator. Domains A, B, C and E could however also be part of the same operator's network, in which case domain D is not applicable. Domain C belongs per definition to the Home Service Provider of the UE #1 on the left hand side of the figure to which the FMC handover service is provided.. Both A and B may be Visited networks, or either one could be part of the Home Service Provider network. In other words the Home Service Provider may either be a fixed or a mobile operator or both.

As the handover procedure is based on SIP signalling between UE and the FMC server it can be supported by the regular roaming interfaces for IMS services.

11.3.5 Handover procedure

Figure 11.3-2 depicts at a high level the signalling sequence for the handover scenario described below figure 11.3-1. For simplicity the IMS CSCF entities are not represented. The SIP signalling follows standard IMS routing procedures to direct the signalling to the FMC application server. A further simplification is that only one visited MIIS is shown which is representative for the case where both accesses are in a single visited network domain.



tbd

Figure 11.3-2 Service Level handover procedure

The session is first established over the most preferred of the available accesses as provided in the UE configuration data. In this scenario we assume this is a mobile packet access of limited bandwidth and no other access is available.

The procedure is as follows:

- After attachment to the mobile access network and regular IMS registration (not shown), UE #1 registers with the FMC application server for the FMC ser vice continuity service. UE#2 is already attached and IM registered.

- UE #1 initiates an IMS session via the FMC server that acts as a Back-to-Back User Agent. Appropriate initial filter criteria (iFC) are used in the S-CSCF to forward the signalling messages from UE #1 to the the FMC server. The signalling sequence follows the regular SDP offer process. The initial offer of UE #1 is for a video call but since the mobile access network does not offer enough bandwidth for a video stream only an audio call is established. After the SDP offer procedure is successfully completed the audio media stream is established.

- UE #1 published its device capabilities in terms of available and active interfaces. A change of location will trigger a new.

- UE # 1subscribes to access network information from the FMC application server

- The FMC application server queries the h-MIIS about the available access networks and conditions in the vicinity of the UE location; the h-MIIS determines which v-MISS(s) to contact and relays the request.

- The FMC application server receives the requested access network information in response to its request

- If the FMC application server finds another suitable access network in the vicinity of a new location of UE #1 , it provides the UE with the required parameters to attach to the other access network; a WLAN fixed access in this example.

- UE #1 attaches to the WLAN, acquires an IP address for the WLAN interface and registers the IP address as of the WLAN interface as its second contact address with the S-CSCF and FMC application server. To save power, the UE may put the WLAN interface in power save mode after the registration has been completed.

- Following the registration, the FMC application server correlates the available information about the user's profile, session preferences including user defined cost limits, available access networks and costs and decides to initiate a handover if the fixed WLAN access network offers a better match for the preferred session profile.

- The FMC application server sends a NOTIFY to UE #1 to activate the WLAN interface and UE confirms successful activation with a 200 OK.

- The handover itself is initiated by the FMC application server including the provision of the SDP information for the video media. By using a third part call control procedure for the handover there is no need for another RINGING 180/PRAK/200 sequence.

- The FMC application server sends the new contact address of UE #1 and the SDP information to UE #2. The video call is now established. The transfer of the audio streams can be seamless if UE #1 temporarily keeps both interfaces active until it receives the audio (and video) information on its WLAN interface.

11.3.6 Co-existence of Service level and Transport level handover

In cases that service continuity is achieved by transport level mechanisms, e.g. through Mobile IP, and the mobile and fixed access provide equivalent QoS (bandwidth, delay, packet loss) the transport level handover can be transparent to the service level. In case the QoS of both accesses is substantially different, the service level needs to be involved in the handover decision process. Providing the service level with full control of the handover process as described above offers the advantage that the service that is provided to the user can continuously be optimized for the access network conditions.tbd

1215 Security mMechanism of Unique User Identityfor IMS based FMC

Access to the IMS session control domain and the services that are built on top of it does require the authentication and registration of users of this domain. Exceptions exist for emergency.

Compared to stationary access in fixed networks, nomadic and wireless access in fixed networks and mobile access in mobile networks face an increased level of security threats. To counter these threats a security framework has been adopted in the mobile world (TS33.203) for IMS access, with the IMS Subscriber Identity Module (ISIM) as a key component. The ISIM contains both User Identity information as well as security mechanisms.

To facilitate FMC it is recommended that FMC terminal implements the ISIM functionality, to provide the same User Identity information and the same level of security, regardless whether the terminal is attached to a fixed or a mobile access. This recommendation does not prescribe how the ISIM functionality is implemented. This may be in the form of a UICC, but other forms of implementation (e.g. “soft” ISIM) are not precluded.

Although full support of ISIM functionality is the preferred solution from a security perspective for IMS access authentication, it is acknowledged that the smooth introduction of IMS will require interim solutions that can support legacy terminals without ISIM functionality. Such interim solutions should still provide an adequate level of protection against the most significant security threats that will exist in early FMC deployments. Use of devices that do support ISIM functionality when these become available at acceptable costs is recommended.

Legacy or early 3G mobile terminals that do not have ISIM and/or do not support IPSec based IMS security mechanism should be supported in an FMC network. The mechanism to do so is described in 3GPP TR 33.978 and is referred to as early IMS security. It relies on bearer level security at the GPRS level based on SIM or USIM. The IMS level signalling, and especially the IMS identities claimed by a user are checked securely against the GPRS level security context.

Legacy or early fixed SIP terminals that do not contain UICC and/or do not support IMS AKA should be supported in an FMC network if connected to a fixed access network. Two mechanisms that are described in ETSI TS 187 003 for this purpose are applicable:

- SIP HTTP digest authentication as specified in RFC 2617
  This method is fully standardised by RFC 3261 for SIP implementations. It does require the secure provisioning of a user specific password on the terminal. The security of this method highly depends on the strength of the chosen password and on the password provisioning method. Appropriate choices are an operator’s responsibility and not standardised.
- NASS-IMS bundled authentication
  This method is similar to “early IMS security” in that it relies on bearer level security, which in

the case of fixed networks is provided by the Network Attachment System. The network attachment in fixed networks is however not provided by SIM functionality, but relies on the implicit authentication of the fixed access line and/or the explicit authentication of a provisioned bearer level user identity and credentials.

During network attachment, the NASS allocates an IP address to the terminal and stores the layer-2 and layer-3 identities in the NASS profile. When the terminal registers with the P-CSCF of the IMS, the P-CSCF queries the NASS to obtain the location information (the access line identity) of the terminal. The P-CSCF embeds the location information into the SIP message and forwards it towards the S-CSCF for verification. The S-CSCF verifies the received location information against the location information in the user profile. The user is authenticated for IMS access if the verification is successful.

Note that with early IMS security, the network authentication is provided by SIM functionality and also the GGSN, HSS and the IMS network entities resides in the home network, so there will be trusted binding between the SIP identity and the network identity. In case of fixed network NASS-IMS bundled authentication the IMS domain will need to have a trusted agreement on the fixed network authentication procedure and binding.

{Editor's Note: Contributions are invited providing more detail on the following topics to further develop this section. Contributions addressing the various different scenarios for different access technologies would be particularly useful.}

- Potential for use of swipe card
- Need to understand full functionality required in IMS-based networks as this may impact what and where information may need to be stored with respect to ISIM functionality
- Authorisation also important in addition to authentication, e.g. in application of toolkit, QoS, validation/accounting/billing for internet usage (e.g. mobile/fixed/business/home)
- DSLAM implementation e.g. in residential applications e.g. using software realisation of ISIM functionality in central office that authenticates physical line or number e.g. for billing
- Software ISIM functionality in central office
- Copper pair association
- Multiple ISIM functionality instantiations per line, perhaps associated with multiple PINs
- "Black phone" support, e.g using SIP user agent, decadic conversion, copper pair association, no mobility support in secure legacy systems
- new functions/features in IMS-based networks that are not available in legacy networks or equipment
- set limits to backward compatibility ("serve as served before")
- currently authentication stops at subscriber level in legacy networks (not at user)
- encourage IMS-based networks to understand the difference between user and subscriber, and how to authenticate each, this is a key issue
- but still need to cope with acquisition and installation of new terminals and equipment
- work in addition to ISIM functionality is still needed
- terminals may not have ISIM card, other mechanisms are possible, ISIM card is not mandatory as an implementation method

- review 3GPP SA2 TLS as another potential security mechanism
- authentication in IMS-based networks should apply to all/any types of terminals that are connected (application-specific details for each access technology)
- need to address AAA issues
- need to address separation of user, terminal and subscriber identities
- many implicit fixed network issues have become unconsciously buried over time
- ISIM functionality is one existing technique in Mobile networks, use the same to facilitate development of IMS-based networks
- Emerging regulatory constraints in respect of blockage of stolen phones

~~[~~*Editor's Note: Contributions are invited providing more detail on these topics to further develop REC.FMC-IMS. Contributions addressing the various different scenarios for different access~~s~~ te~~te~~chnologies would be particularly useful.*~~]~~

~~]~~

~~13~~16 Regulatory Compliance

~~13.1~~16.1 International Emergency Preference Schemes in FMC Networks

Supplement 47 to the ITU-T Q series Recommendations "Emergency Services for IMT-2000 Networks – Requirements for Harmonization and Convergence" is an information document that is intended to outline the requirements and provisions for Emergency Services for IMT 2000 systems.

This disument is a compilation from sources outside the ITU (e.g., administrations, Standards Development Organizations, and the Third Generation Partnership Projects (3GPP and 3GPP2)).

The guidance in this document should be adopted in developing FMC requirements.

~~13.2~~16.2 Lawful Interception in FMC Networks

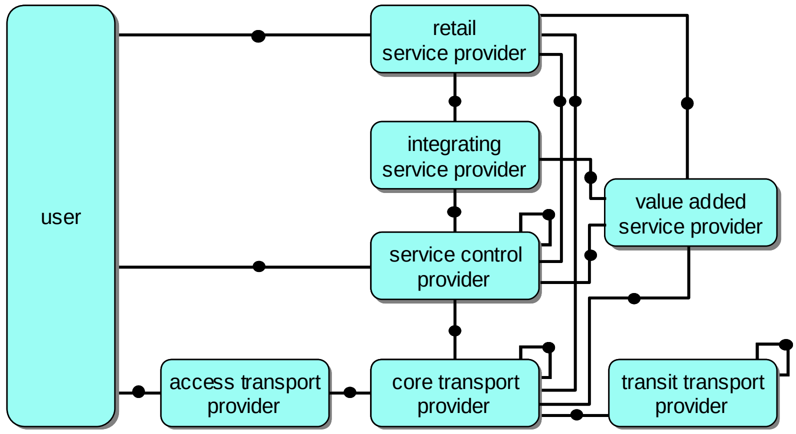
The lawful interception aspects of FMC networks are not addressed in this Recommendation.

~~Appendix FMC Enterprise Role Model~~

~~The primary purpose of an enterprise model, according to Recommendation Y.110 [1], is to identify interfaces that are likely to be of general commercial importance. In order to do so, a number of roles are identified which describe a reasonably well-defined business activity that is unlikely to be subdivided between a number of players. Players may aggregate roles as they see fit. Therefore an enterprise model does not limit players in anyway, but it does identify the roles that the FMC architecture should enable.~~

~~The enterprise role model for FMC is shown in figure 1.~~

~~It identifies the following roles:~~



3. *User:* The role in which a person or other entity authorised by a customer uses services subscribed to by the customer. In the figure the user includes the customer role, but these may be separate roles.

4. *Retailing Service Provider:* The role that has overall responsibility for the provision of a service or set of services to users. The user profile is maintained by the retailing service provider. Service provision is the result of combining retailing service provider services with wholesale services from at least the access and core transport provider roles and at most from all other provider roles.

5. *Integrating Service Provider:* The role that creates unique new service offerings from the wholesale services from other roles. A Virtual Network Operator is an example of an integrating service provider.

6. *Service Control Provider:* The role that provides, session and call control and related services such as registration, presence and location, wholesale to retailing and integrating service providers.

7. *Value Added Service Provider:* The role that provides value-added services (e.g. content provision or information service) on top of the basic telecommunications service provided by the service control provider role. It does not provide a complete service on its own.

8. *Core Transport Provider:* The role that provides connectivity either end-to-end or in part and related services such as registration for connectivity service by combining its own services with those of the access transport provider and transit provider roles as necessary

9. *Access Transport Provider:* The role that provides a wholesale connectivity service between the user and a core transport provider

10. *Transit Transport Provider:* The role that provides a wholesale connectivity service between core transport providers, where necessary in conjunction with other transit transport providers. It also provides related DNS services.

Figure 1 - FMC enterprise roles

The transport roles are based on the domains as they have been defined by 3GPP in ETS 123.101 [2]. Unfortunately it is not possible to reuse the terminology as the distinction between Serving/Visited and Home network domains is a functional and not an enterprise role one. The same player will support both functions depending on the subscription of the user. By lack of a better term we have used the term Core for the Visited/Home network role. The Access and Transit service provider roles map directly on the respective domains in [2]. Note that 3GPP uses the term Core network domain for the combination of Visited, Home and Transit network domains. The loops at the transport provider roles indicate that a Visited core transport provider may have a direct relationship with the Home core transport provider or via one or more Transit transport providers. Service control providers may also support visited and home network functions.

Of the six wholesale roles four have a relationship with the retailing service provider role that holds the user profile database. A retailing role player may hold the user information for all four roles, or a user may have a relation with multiple retailing role players.

[1] ITU-T Recommendation Y.110 (1998), Global Information Infrastructure principles and framework architecture

[2] ETS 123.101 v6.0.0: Universal Mobile Telecommunication System (UMTS); General UMTS Architecture

Inputs for Further Work (from Stage-1)

Access Mechanism in PSTN/ISDN Fixed Networks

[Editor's Note : References of ETSI's standards on Fixed Line SMS may be introduced.]

An available candidate solution for this area is the European Telecommunications Standards Institute (ETSI) recently standardised User Based Solution (UBS) based on 1200 baud, asynchronous half-duplex FSK (Frequency Shift Keying) modulation for transferring messages in-band to and from the subscribers of PSTN networks supporting CLIP (Calling Line Identity Presentation), with the help of special capability fixed line SMS terminals.

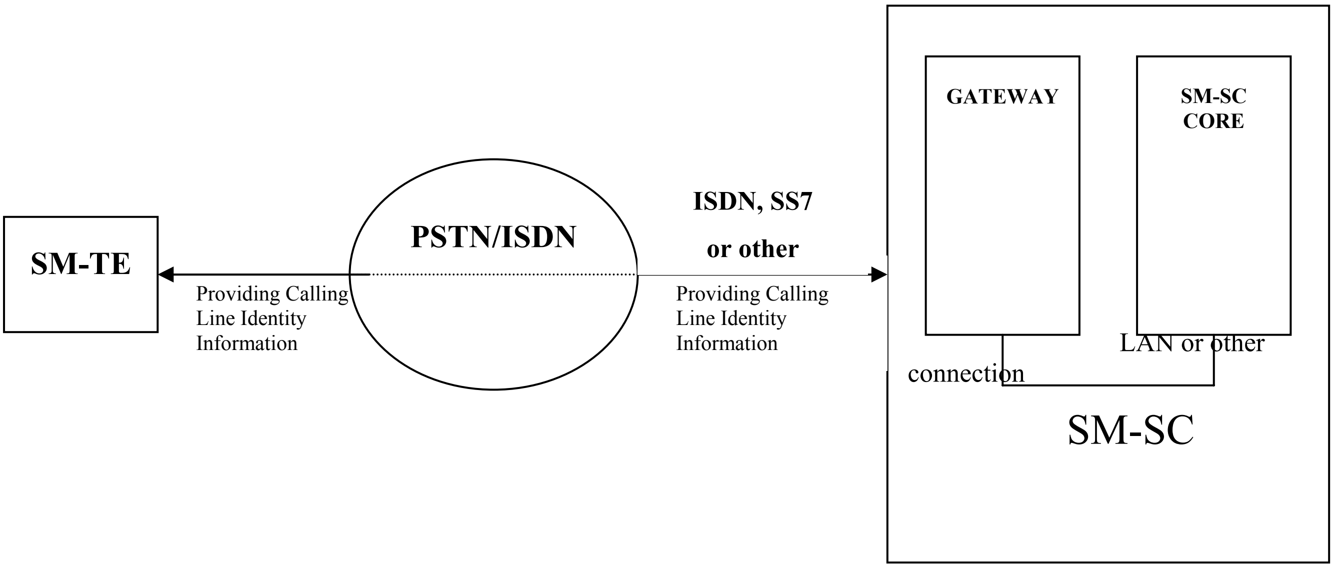


Figure B.1 - ETSI's Fixed SMS Architecture

It is important to note that ETSI's standard has paved the way for a standardised protocol in the PSTN local loop. It is also important to note that the PSTN/ISDN network underneath remains totally transparent to the message transfer. This concept can be extended to introduce discrete terminal mobility in fixed networks by allowing user registration, authentication and de-registration in the Fixed Mobile Plane.

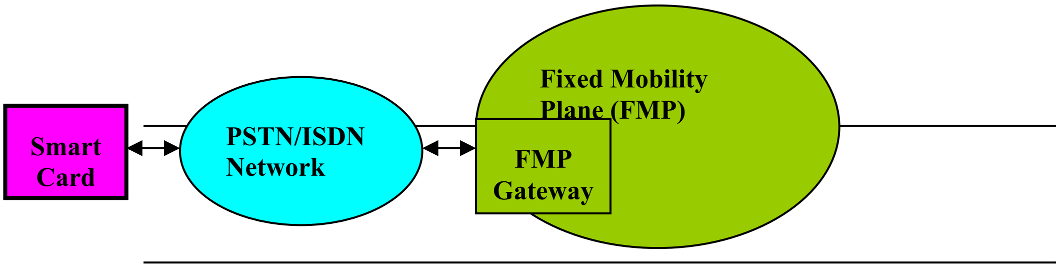


Figure B.2 - In-band Signalling Procedures for Fixed Mobility

As shown in Figure B.1 the signalling exchange between the User Terminal and FMP may be in-band. This will meet the signalling requirements to support mobility and most mobile-like services in PSTN networks. In case of data calls, bandwidth limitations of the underlying analogue access will obviously remain, yet will be sufficient for many applications. In the case of digital local loop (xDSL), the limitations will be much less.

User profile in fixed-mobile convergence

With the mobile user's ability to move between fixed networks as well as between a fixed network and an IMT-2000 network, and support of VHE, one of the challenging issues will be access to the user's profile while roaming.

This section describes a functional architecture for accessing user profiles as well as user data.

Annex AMobile user data in fixed networks

The requirements for mobility in fixed networks have been studied earlier, for e.g., in the study of Universal Personal Telephony (UPT)

[Editor's note: The following reference may be incorporated in the References section :

Q.1521 (06/00) Requirements on underlying networks and signalling protocols to support UPT*]*.

In case of FMP, concerning the user profile, the following was identified:

– User profile management: handling of user profile, the update of these data, either by the user or by the service provider, retrieval of user data. The user profile comprises:

- o an access profile: basic user data such as identification, exhaustive list of subscribed services, and optionally service priorities
- o specific service profiles for each service. These data are used by various equipment, switches, call servers, multimedia servers, SCPs, etc. They are currently located close to service processing for fixed users, and are therefore stored on the same wide range of equipment.

[Editor's note: this text needs to be improved to reflect distribution across multiple places in the network.] As the user moves across the network, the user data can no longer be stored in a specific fixed location in one piece of equipment as was initially done for fixed users (without mobile services): services execution is no longer always carried out on the same equipment, but may change as the user moves, e.g., call forwarding. *[Editor's note: this example should be fleshed out to illustrate the point being made.]* The support of mobility in a fixed network requires the storage

of all user data in a user profile. From a functional point if view, this profile is unique, event if it may be implemented across several pieces of equipment.

The service specific parts of the user profile are not *a priori* stored in the same functional entity as other parts of the user's profile. It is therefore necessary to have a common access profile in order to handle the service access and interactions in an efficient manner.

Additional requirements for supporting mobility are briefly mentioned here, as these procedures may need interaction with user data:

- Identification and authentication
- Location management : includes the handling of location data, the update and cancellation of user location data, as well as the retrieval of these data
- Routing addresses management : handling of routing address and optionally the retrieval of such addresses when required

Conclusion #1 : The introduction of mobility in fixed networks requires centralized user profiles (from a functional point of view), which can be accessed by networks entities (e.g., call servers, SCPs, switches, etc.) called clients.

B.2.2 User data in converged fixed and IMT-2000 networks

With mobility now included for fixed access in addition to IMT-2000 accesses, there is a specific issue on mobility management and user data access when discussing convergence of fixed and IMT-2000 systems.

One aspect is the ability of a user to roam between a fixed access (connected to public fixed network) and a wireless access (connected to public IMT-2000 network). Concerning the user data, a first set of requirements for such a service includes the following topics:

- when the user is granted access to network resources and services, the user must de identified as a single subscriber in order to achieve VHE
- some user data needs to be accessed by both the fixed network entities and IMT-2000 network entities: they are at least general data on the user and on the services the user has subscribed to (this is further developed in the next section.)

In the case of users able to roam between different access networks based on IMT-2000 networks and fixed networks, the user data needed for mobility management and VHE can be categorized into :

14Data relevant to both mobility schemes (e.g., network routing address): these data must be accessed and may be updated by both IMT-2000 and fixed network entities. Among those, some need to be shared, and are referred to as "common data".

15System-specific data which will be accessed by only one system. These can be considered internal to a specific access or network, and will not be considered further here.

Conclusion #2 : Fixed-mobile convergence and the introduction of fixed-mobile services require a single user profile (from a functional point of view), which contains common user data (i.e., data needed in both the fixed and mobile environments) and which can be accessed by both fixed and mobile networks entities (e.g., call servers, SCPs, switches, etc. , called clients.)

B.2.3 Common user data for fixed and IMT-2000 networks

The data for fixed and IMT-2000 systems identified as "common" (it is not discussed here whether these are mandatory or optional):

- user id
- other user ids (e.g., E.164 id for circuit switched services, e-mail addresses, etc.)
- Authentication data (e.g., method, authentication centre id)
- Routing addresses (e.g., E.164 id for circuit based services, IP addresses, etc.)
- Id of local register for user profile copy in the visited environment
- Service related data when these services can be delivered on various access technologies (e.g., call forwarding and voice mail, etc.)

Service related data may only be accessed by various client network elements which are implemented in various service platforms. User service data may be stored on a wide range of equipment, and a limited set of user service data needs to be easily accessible. No implementation options are excluded; for example, the easily accessible service data may be limited to a pointer to the whole set of user service data which may be stored in a separate service specific equipment.

B.2.4 Functional architecture for accessing user profiles

From the above analysis, the support of mobility in fixed networks and the support of VHE in the context of fixed-mobile convergence requires a centralized user profile (from a functional point of view) which can be accessed by client entities in fixed and IMT-2000 systems. This requires a unique user profile stored in such a way that it can be accessed by a Profile Server (PS). Figure 5 provides an overview.

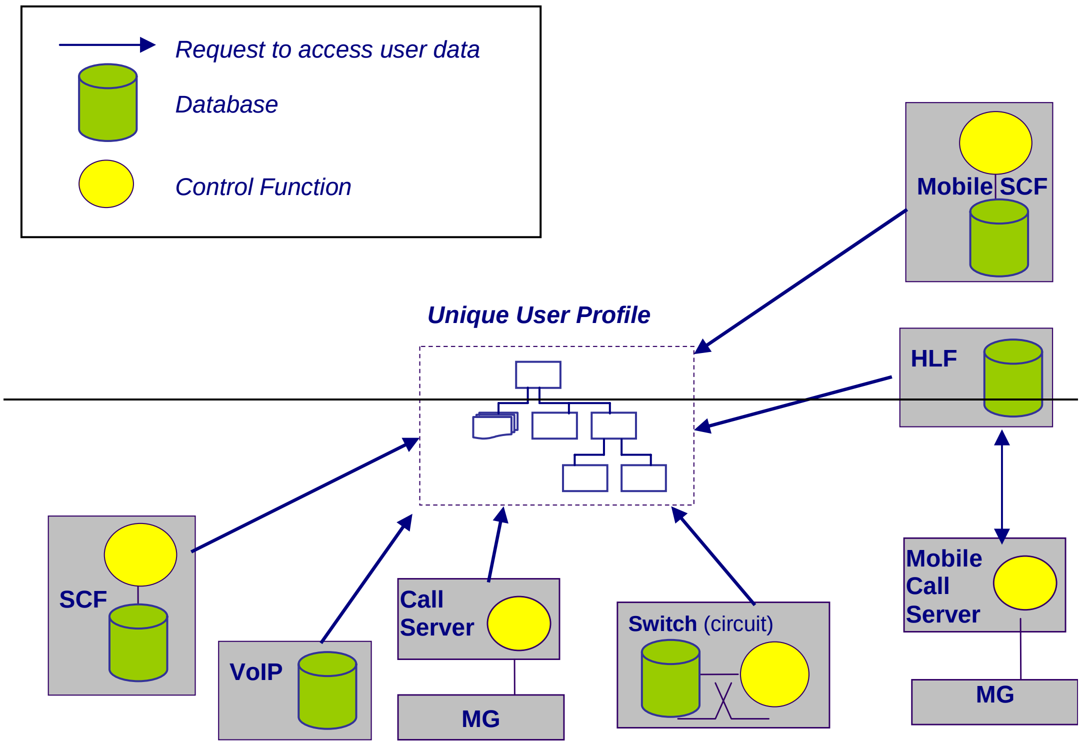


Figure B.3: Unique user profile

The following section provides more details on the implementation of the user profile. It can be accessed via a Profile Server, which includes a database and some limited intelligence in order to process efficiently the requests.

B.2.5 Functional architecture for Core Profile Server

This section is focused on the architecture of the profile servers needed to store user data for mobility in fixed networks and for fixed-mobile convergence. This section is intended for profile servers which are required for mobility in fixed networks. It may also be used for fixed mobile convergence. In addition, a similar architecture may be used between different IMT-2000 systems (inter-family.)

Based on the above types of user data and the first requirements, the functional architecture shown in Figure B.4 is proposed for the profile server mentioned in Figure B.3.

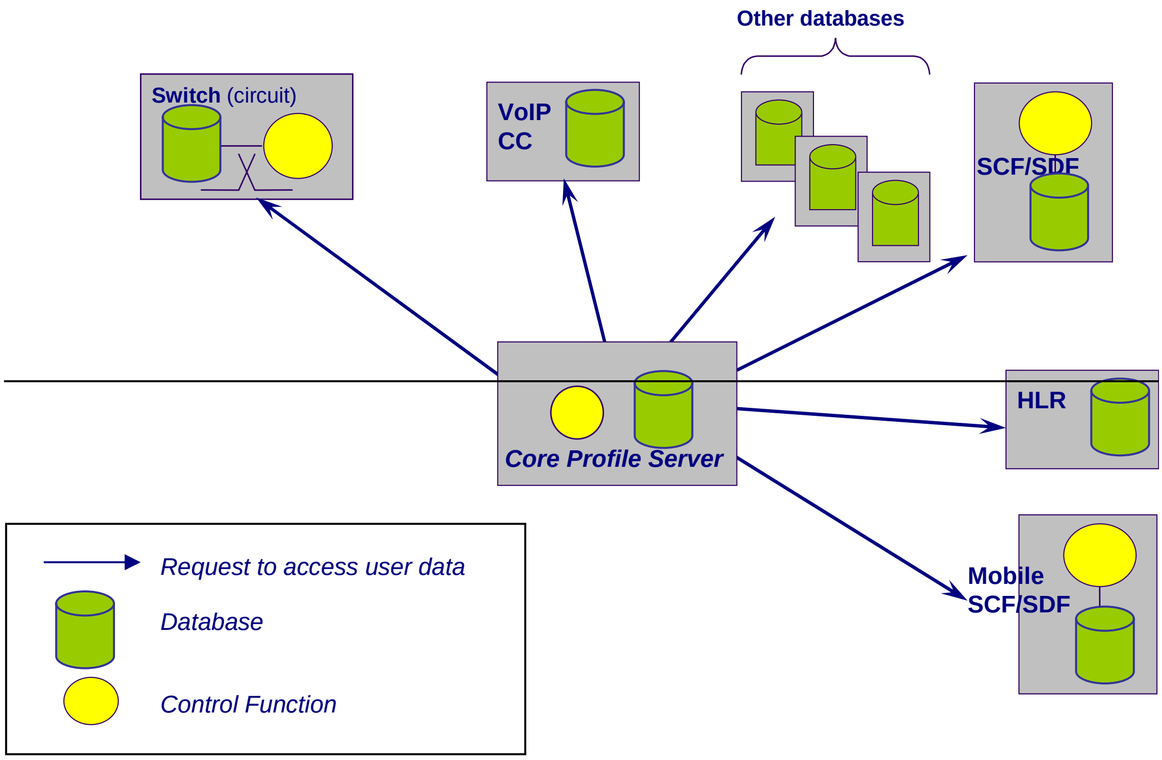


Figure B.4: Proposed functional architecture for the Profile Server

- The Core Profile Server includes at least the common user data listed in section B.2.3.

Further study is needed for the modelling and detailed content of the common data. *[Editor's note: further contributions are requested.]*

B.2.6 Advantages and Drawbacks of the proposed architecture

The proposed architecture has the following advantages:

- It provides a single user profile for mobility in and across fixed and IMT-2000 networks.
- A single interface is needed to access the user profile from any point; although the specific protocol may depend on the equipment sending the request.
- The user profile modelling hides the specific data structures of each service profile (and its potential evolution) by providing a single model to all client network entities.

- It enables the easy introduction of new network entities, either as client or a user service profile server, without any impact on existing infrastructure. In a similar manner the evolution of one network entity has no impact on other equipment except the Profile Server.
- It takes into account the existing infrastructure and the facts that user data are currently stored in a wide range of equipment.
- It enables a smooth evolution towards a "single centralized profile" architecture.

B.2.7 Parallel operation of H.323, SIP and BICC call control protocols

[Editor's note: the intent of this section needs to be clarified.]

Related Specification Work Outside ITU-T

Considerable work has already been done on related concepts such as VHE (Virtual Home Environment) to meet some of the objectives of FMC. The VESPER consortium consolidated work done by various forums and activities such as Parlay, Open Service Architecture (OSA), Telecommunications Service Access and Subscription (TSAS) with inputs from standardization bodies such as the 3GPPs (through their partner SDOs) and the ITU.

[Editor's Note : Following reference on UCI, an ETSI guideline may be incorporated at appropriate place and suitable reference number be given below.

ETSI EG 202 072 V1.1.1 (2002-09) Universal Communications Identifier (UCI): Placing UCI in context; Review and analysis of existing identification schemes.]

Similarly, ETSI's work on UCI (Universal Communications Identifier) makes it possible for a subscriber to have a unique global identity for all his communications needs including email, fax, mobile access, fixed line access, etc.

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~~Informative~~

~~Introduction~~

~~[Editor's notes: further contributions are required to move the content of this annex into the main text of REC.FMC-IMS]~~

~~Modelling approach~~

~~This modelling approach is proposed to compliments of FRA with bottom up analysis with the existing functional models for the fixed and mobile networks. The purpose is to identify existing interfaces with applicable FMC domain boundaries and investigates on the bases of FRA which new functions are required for FMC.~~

~~Scope of the FMC functional model~~

~~Depth~~

~~By using a bottom up approach we automatically inherit the granularity of the functional models of the networks that we consider. These may not always be on the same level, but this would only be a problem if a particular function appears to straddle an FMC domain boundary. In such a case we should liase with the group that owns the model to find a solution.~~

~~To make sure that all network aspects are considered we propose to cover all necessary network functions, including charging and management functions.~~

~~Width~~

~~There is no restriction in principle to the network technologies that the FMC functional model may cover, including the full breadth of the different access network technologies. The only constraint is that a functional model for a network technology is available for our use. We should not want to develop basic models as part of our work.~~

~~In terms of support for session continuity and possibly seamless service between access domains we propose to limit our considerations to new functionality in support of handover between fixed and mobile networks. For this we propose the following narrow interpretation of a fixed access network: a network where the piece of user equipment that connects to it is stationary (has a permanent location). The connection to the network may be wireless, but is only considered to be a fixed connection if it is terminated in the User Equipment Domain by a stationary station like a modem or gateway.~~

~~**An IEEE 802.16 based network as is being defined by the WiMAX Forum is still difficult to classify with this definition of fixed. It supports both stationary (802.16d) as well as mobile stations (802.16e) and can therefore be considered as a fixed mobile converged technology in its own right. It should therefore certainly be studied and represented in our functional model, but the ownership for the functionality, including the functions that support handover of dual-mode 802.16/802.11 terminals within a WiMAX network lies clearly with IEEE802.16 and the WiMAX Forum. What we may want to investigate is how handovers can be achieved between a WiMAX and a fixed only network.**~~

~~**Order in which to progress the work**~~

~~**As a standards activity, the order in which we develop the functional model is ultimately determined by contributions. We need to establish a baseline however and it is proposed to use the existing models from 3GPP for UTRAN and I-WLAN and from TISPAN for xDSL access as a starting point and synthesize a merged FMC baseline model from these existing models. We propose to further develop the baseline model, by adding the following components, but not necessarily in the order listed:**~~

~~**□ functionality of a WiMAX access domain**~~

~~**□ functionality of a Cable access domain**~~

~~**□ functionality of a FTTX access domain (may be already covered by the TISPAN model)**~~

~~**□ functionality to provide handover for a multi-mode terminal between a private WLAN access point connected to a fixed network and a mobile network access point**~~

~~**□ the same as above, but for a Bluetooth access point**~~

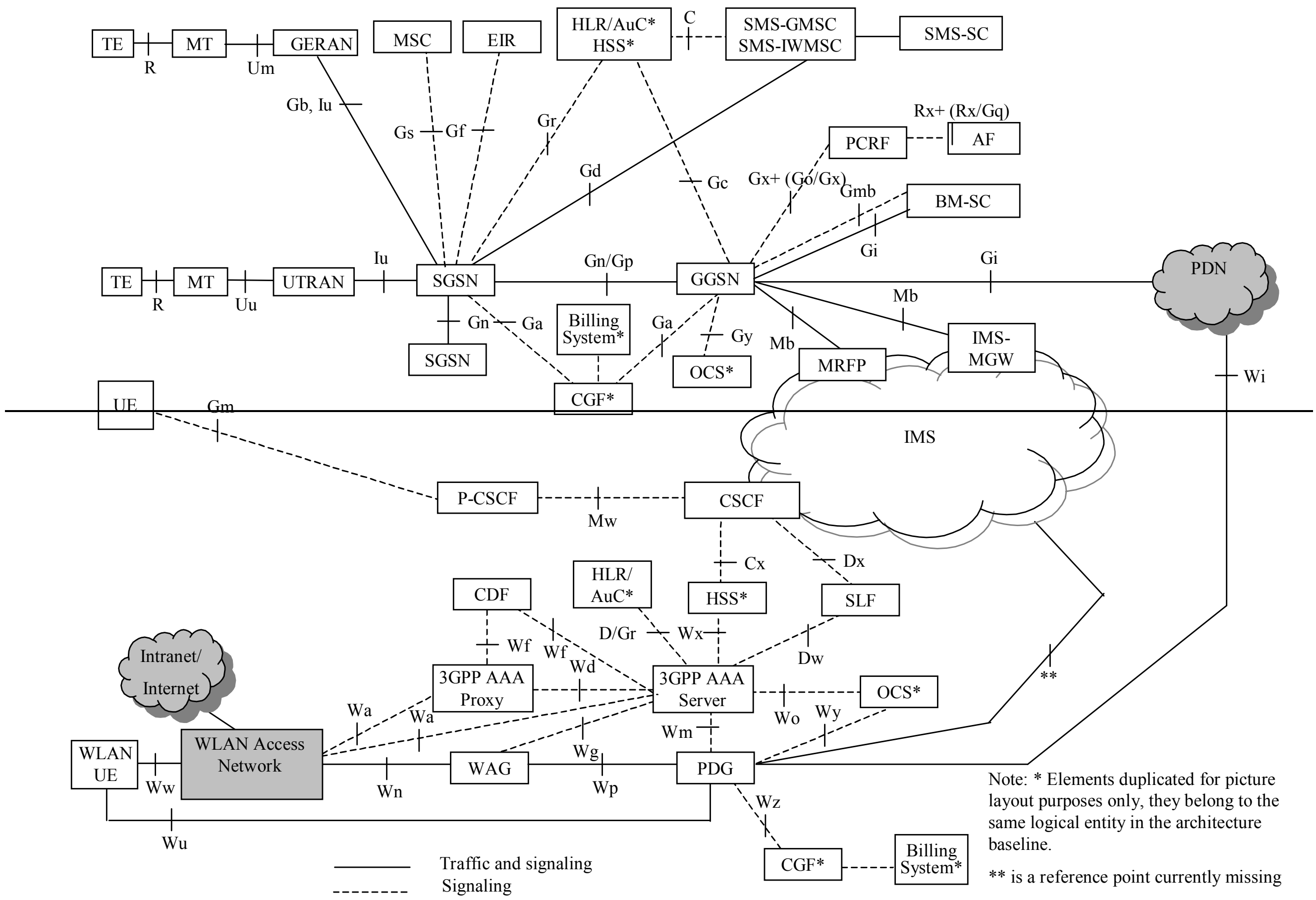
~~**□ functionality of a 2G GERAN network**~~

~~**□ functionality to support Voice Call Continuity (VCC) for a multi-mode terminal between a 2G Circuit Switched domain and a PS domain with IMS session control.**~~

~~**□ functionality of Evolved UTRAN**~~

~~**Baseline model development**~~

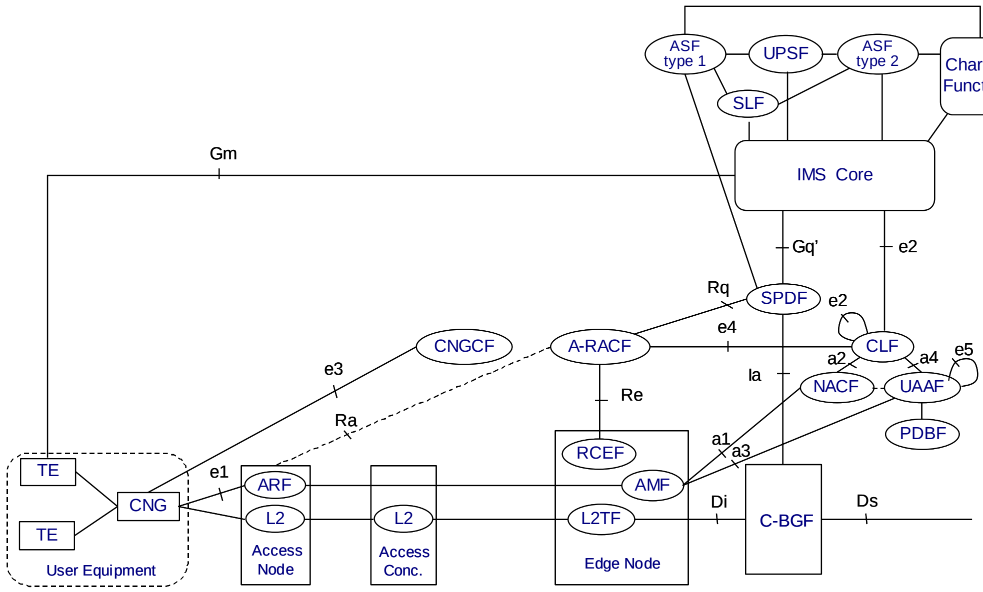
~~As proposed above, we want to take the existing functional models from 3GPP and ETSI TISPAN to establish a baseline model. A composite model for 3GPP UTRAN and I-WLAN can be found in TR 23.882 V0.9.0 and is reproduced below:~~



~~TR 23.882 Figure 4.1-1. Logical baseline architecture for 3GPP~~

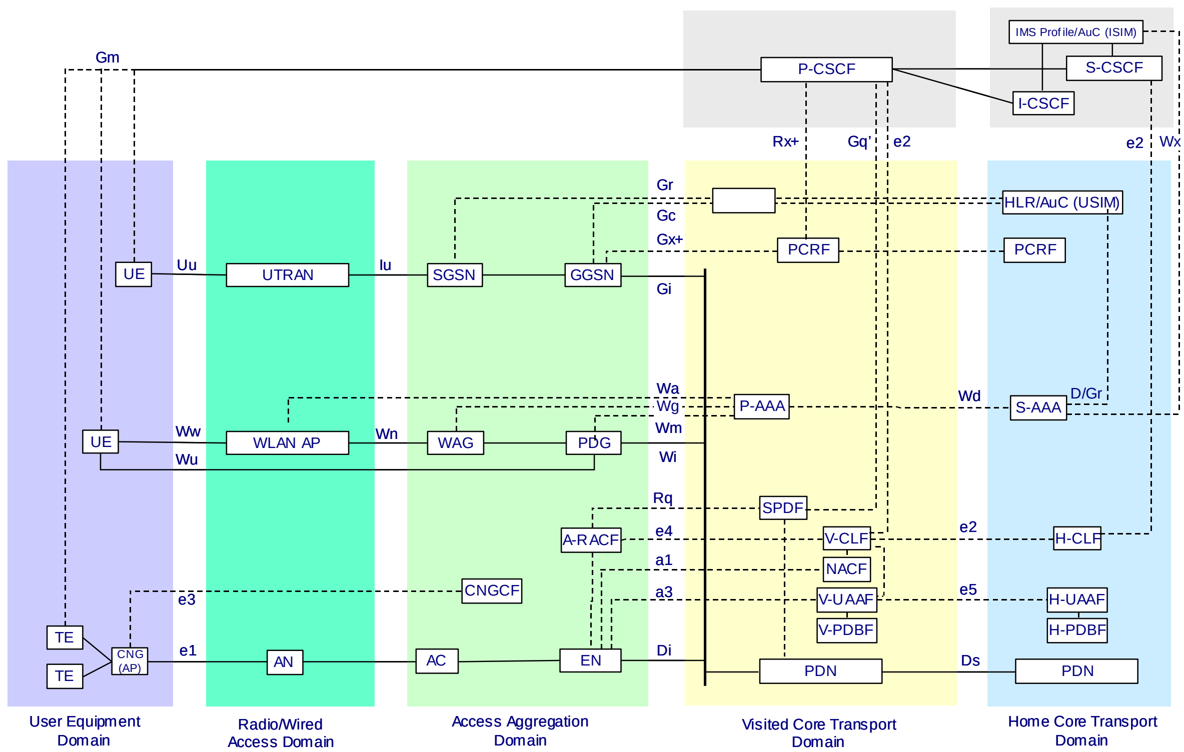
~~Note that the I-WLAN model in this figure is a merge of the I-WLAN roaming and non-roaming deployment scenarios.~~

~~The TISPAN documentation does unfortunately not contain a single figure that represents all of the functions that are defined by TISPAN for xDSL access in a similar style. The following figure combines the information from the TISPAN architecture (ES 282 001), subsystem architecture (ES 282 003, ES 282 004 and ES 282 007) and security architecture (TS 187 003) documents.~~



~~TISPAN functional architecture~~

~~We have taken these functional models and mapped them on the FMC domain architecture in the following way:~~



~~FMC functional model with common Session Control Domain~~

~~**[Note: PCRF partitioning is not finalized yet. Architectural component partitioning is still under study]**~~

~~**Bearing in mind that we are not so much interested in the interfaces within a domain, only the interfaces that cross FMC domain architecture boundaries have been labelled. The current figure brings out the functionality for transport, network attachment, resource and admission control, and session control only. We intend to add the Application Service Domain and its interfaces in a next version of the figure. The functionality for charging and management is also still to be added, but this may be better covered in a separate figure.**~~

~~**The figure shows a partial FMC implementation with a converged Session Control Domain. We propose that this figure is used as a starting point to develop a baseline functional model for FMC. Once we have established an agreed baseline model we can study convergence of the Core Transport Domain on that basis.**~~

~~**New functions will need to be defined to support handover between fixed and mobile domains. The 3GPP GAN (UMA) architecture could be used as a starting point, but it needs to be studied how similar functionality to the GAN Network Controller, that can exchange information about the radio bearer with the user equipment, may be positioned in the overall architecture.**~~

~~Informative Annex~~

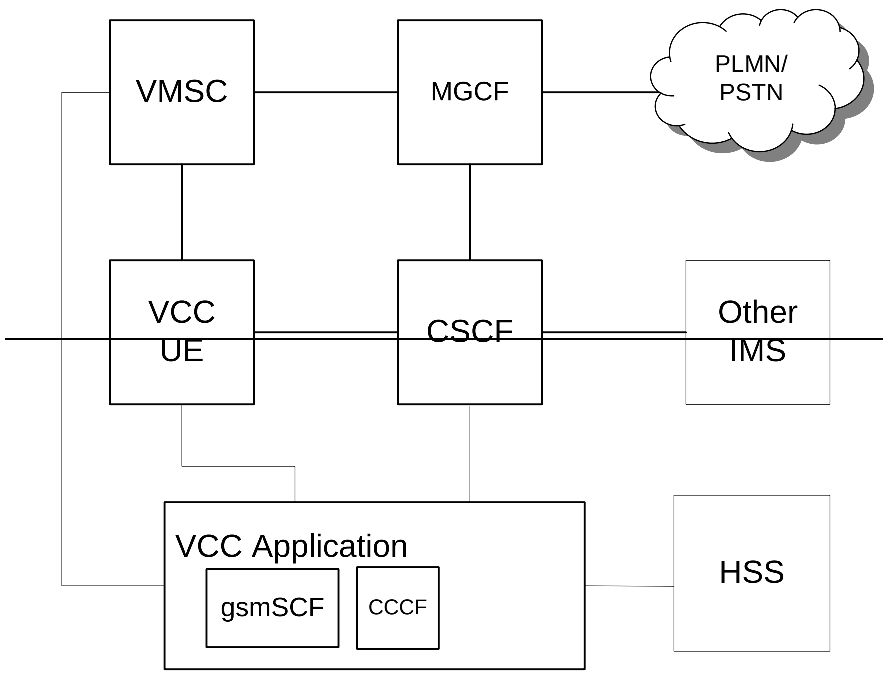
~~Convergence Architectures from other SDOs~~

~~Introduction~~

~~For ease of reference this annex summarizes a number of convergence architectures that are being progressed in other SDOs. Once agreed input is available it may be captured in the body of the recommendation in an appropriate way. This annex will be deleted in the final version of this recommendation.~~

~~Voice Call Continuity (3GPP)~~

~~The VCC reference architecture is depicted in the figure below:~~



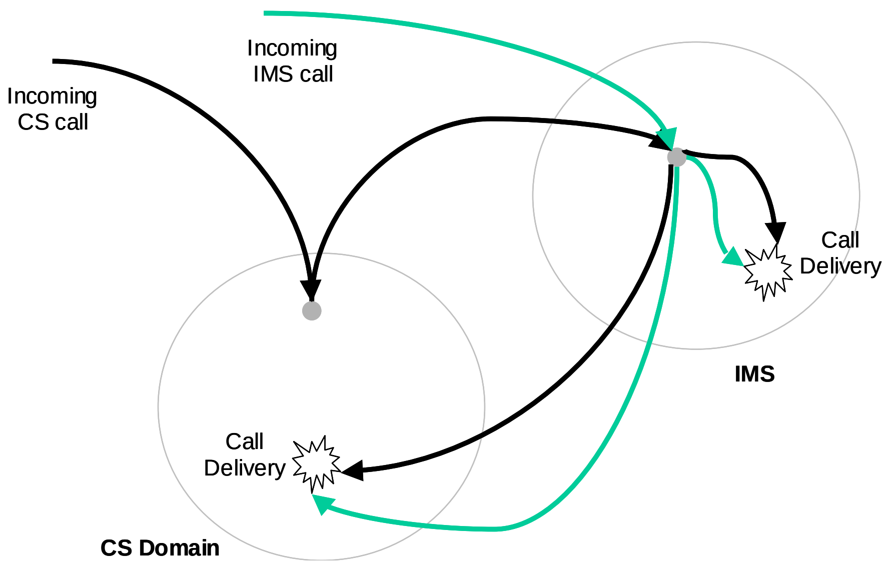
~~Figure 8 – TS23.206v0.3.0 figure 1 VCC reference architecture~~

~~The Call Continuity Control Function (CCCF) is implemented as an IMS application server. It controls the establishment of call legs required to transfer a call between a CS and PS-IMS domain. After IMS registration according to the regular IMS procedures information can be exchanged between the VCC UE and CCCF.~~

~~For calls originating in the IMS domain initial Filter Criteria for the user result in the routing of the IMS originating sessions to the CCCF's IMS-AS in the home IMS network, where the CCCF uses 3rd party call control to initiate a call to the remote party on behalf of the user. For calls originating in the CS domain CAMEL service triggering is used at the VMSC towards the gsmSCF function of the CCCF. The CCCF return routing information to the to the VMSC, that is used by the VMSC to route the call towards an MGCF in the user's home IMS network. The CCCF terminates the incoming leg towards the original called party acting as a Back toBack User Agent (B2BUA).~~

~~For terminating calls that are incoming in the IMS domain the CCCF is invoked and it selects the terminating network as part of the termination service logic for the user. If the call is to be terminated in the IMS domain, the CCCF acts again as a B2BUA using 3rd party call control to establish a normal IMS session setup towards the terminating VCC UE. For calls incoming from the CS domain it is necessary to anchor the call in the IMS domain. Since this is in the home domain, it is an operator decision how the anchoring is achieved. CAMEL triggering could be used, but other methods like dedicated trunk groups at the GMSC or the use of a local number portability database are also possible.~~

~~The routing of terminating calls is depicted in the figure below.~~



~~Figure 9 – VCC call termination~~

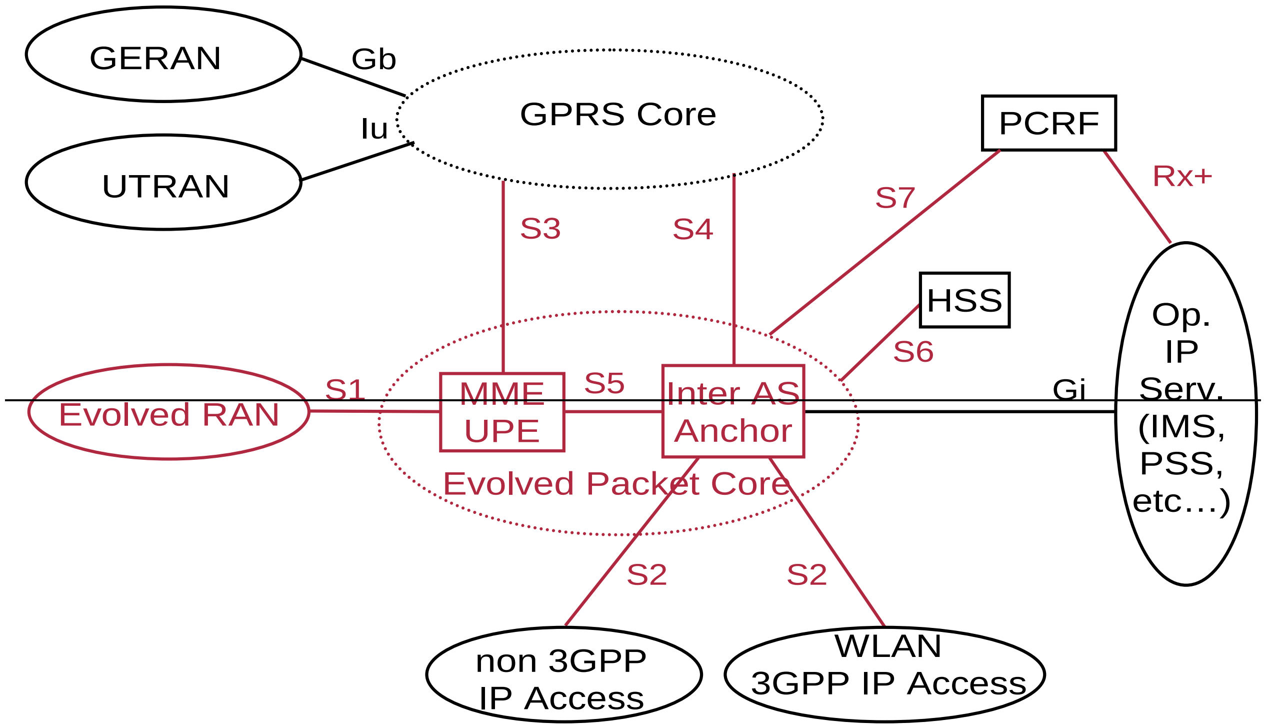
~~Domain transfer is initiated by the VCC UE. For a transfer from a CS to a PS-IMS domain the UE sends a n SIP INVITE to the CCCF to initiate the transfer procedure. For a transfer from a PS-IMS to a CS domain the UE initiates a CS call towards the CCCF. The CCCF performs the transfer of IMS leg to CS using SIP Session Transfer.~~

~~The bearer path interruption due to the switchover is estimated to be in the 100 – 200 ms range.~~

~~SAE (System Architecture Evolution) based Convergence (3GPP)~~

~~The architectural evolution of 3GPP mobile networks is currently the subject of a feasibility study in 3GPP SA2. The objectives of the study are not only to provide higher data rates and lower data and control plane latency, but also to provide service continuity between the I-WLAN and 3GPP PS domain and terminal mobility between different access networks in general. The figure below shows the high level architecture for the evolved 3GPP system for the non-roaming case:~~

~~Editors note: This figure is subject to change since the study is ongoing. It should be replaced in due course by the final version, preferably for the roaming case.~~



~~Figure 10 - TR23.882 v1.0.0 - Figure 4.2-1. Logical high level architecture for the evolved system~~

~~The significance of the 3GPP study for FMC is that it includes the connection of a non-3GPP IP access to the Evolved 3GPP Packet Core network, which may be a fixed access network. As is shown in the figure the non 3GPP access network will be connected to an Inter AS Anchor function, so that mobility between the fixed access and a 3GPP could in principle be supported, for instance using Mobile IP.~~

~~The evolved 3GPP architecture is mobile network centric in the sense that the 3GPP specific MME/UPE mobility function is depicted as part of the evolved packet core. In a roaming scenario the MME/UPE will be in the visited and the Inter AS Anchor in the home network. It is the latter network that can be mapped on the FMC core transport home domain, and hence the part of the architecture that may contain FMC functions to support FMC on the network layer.~~

~~A detailed analysis of the required FMC functions has to wait for a further functional decomposition of the roaming architecture.~~

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